2. Subbasin Assessment – Water Quality Concerns and Status

2.1 Water Quality Limited Segments Occurring in the Subbasin

Section 303(d) of the CWA states that waters unable to support their designated beneficial uses and do not meet water quality standards must be listed as water quality limited waters. Subsequently, these waters are required to have a TMDL developed to bring them into compliance with water quality standards. Tables 4 and 5 show the pollutant listings and the designated beneficial uses for each §303(d) listed tributary in the basin. Not all of the water bodies will require a TMDL, as will be discussed later. However, a thorough investigation using the available data was performed before this conclusion was made. This investigation, along with a presentation of the evidence of non-compliance with standards for several other tributaries is contained in the following sections for each tributary.

Table 4. §303(d)[1] Listed Segments in the Mid Snake River/Succor Creek Basin.

Water Body	Segment ID and AU	Boundaries	Listing Basis[2]	Pollutants
Snake River	2670 006_07	CJ Strike Res. (below dam) to Castle Creek	305(b)	Sediment
Snake River	2669 006_07	Castle Creek to Swan Falls	305(b)	Sediment
Snake River	2668 006_07, 001_07	Swan Falls to Boise River	305(b)	Bacteria, dissolved oxygen, flow alteration, nutrients, pH, sediment
Birch Creek	2684 021_02, 03, 04	Headwaters to Snake River	305 (b) app. D	Sediment
Brown Creek	2682 019_02, 03, 04	Headwaters to Catherine Creek	BURP 305 (b) app. D	Sediment, temperature
Castle Creek	2680 014_03, 04, 05	T5SR1ES28 to Snake River	305 (b) app. D	Temperature, sediment, flow alteration
Corder Creek	2685 025_02	Headwaters to Snake River	305(b)	Sediment
Cottonwood Creek	None 003_02	Headwaters to Succor Creek	Public Comment DEQ Temp Study	Temperature
Hardtrigger Creek	2675 008_02	Headwaters to Snake River	305(b)	Sediment

Water Body	Segment ID and AU	Boundaries	Listing Basis[2]	Pollutants
Jump Creek	2673 005_02,03	Headwaters to Snake River	SSOC Basin Status Report	Habitat alteration
McBride Creek	2672 004_02,03	Headwaters to Oregon Line	305 (b) app. D	Flow alteration, sediment, temperature
North Fork Castle Creek	2680 014_02a	Headwaters to Castle Creek	Added by EPA	Temperature
Pickett Creek	26810 16_02, 03	T5SR1WS32 to Catherine Creek	305(b)	Sediment
Pickett Creek	6681 016_02	Headwaters to T5SR1WS32	305(b)	Flow alteration, sediment, temperature
Poison Creek[3]	2687 006_02, 03	Headwaters to Shoofly Creek	305(b)	Sediment
Rabbit Creek	2677 026_02	Headwaters to Snake River	Idaho Rivers United (IRU)	Sediment
Reynolds Creek	2676 009_04	Diversion to Snake River	IRU	Sediment
Sinker Creek	2679 006_03	Diamond Creek to Snake River	305(b)	Flow alteration, sediment, temperature
South Fork Castle Creek	2683 014_02	Headwaters to Castle Creek	305 (b) app. D BLM	Bacteria
Squaw Creek	2674 007_02, 03	Headwaters to Snake River	Added by EPA	Temperature
Squaw Creek	2674 007_03	Unnamed tributary 3.9 km upstream of river to Snake River	Public Comment DEQ Temp Study	Sediment, temperature
Succor Creek	2671 002_04	Oregon line to Snake River.	305(b)	Sediment
Succor Creek	6671 002_02, 03	Headwaters to Oregon line	305(b)	Flow alteration, sediment, temperature

[1]Refers to a list created by the State of Idaho in 1998. Monitoring data were used to identify water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303subsection “d” of the Clean Water Act.

[2]These are the state, federal or private actions that resulted in the stream being placed on the 303(d) list.

[3]Poison Creek appears on the 303(d) list under HUC 17050103. This is a mistake. The Poison Creek that is in HUC 17050103 is not 303(d) listed. However, Poison Creek is evaluated as part of this subbasin assessment

2.2 Applicable Water Quality Standards

Idaho adopts both narrative and numeric water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity. By designating the beneficial use or uses for water bodies, Idaho has created a mechanism for setting criteria necessary to protect those uses and prevent degradation of water quality through anti-degradation provisions. According to IDAPA 58.01.02.050 (02)a "wherever attainable, surface waters of the state shall be protected for beneficial uses which includes all recreational use in and on the water surface and the preservation and propagation of desirable species of aquatic biota." Beneficial use support is determined by DEQ through its water body assessment process. Table 5 contains a listing of the designated beneficial uses for each listed segment. Table 6 is a summary of the water quality standards associated with the beneficial uses. For streams with no designated beneficial uses, cold water aquatic life and recreation are presumed to be uses. The following discussion focuses on beneficial uses and the water quality criteria, both narrative and numeric, that apply to each of the listed water bodies. A more detailed explanation of the numeric water quality targets developed as an interpretation of the narrative standards for nutrients and sediment can be found in the Water Quality Targets section of this TMDL.

Table 5. Mid Snake River/Succor Creek Subbasin Designated Beneficial Uses

Water Body	Designated Uses[1]	1998 §303(d) List[2]
Snake River: CJ Strike Dam to Castle Creek	CW PCR, DWS, SRW[3]	Sediment
Snake River: Castle Creek to Swan Falls Dam	CW, PCR, DWS	Sediment
Snake River: Swan Falls Dam Idaho/Oregon Border	CW, PCR, DWS	Bacteria, dissolved oxygen, flow alteration, nutrients, pH, sediment
Birch Creek	No designated uses	Sediment
Brown Creek	No designated uses	Sediment, temperature
Castle Creek	CW, SS, PCR	Temperature, sediment, flow alteration
Corder Creek	No designated uses	Sediment
Cottonwood Creek	No designated uses	Temperature
Hardtrigger Creek	No designated uses	Sediment
Jump Creek	CW, PCR	Habitat alteration
McBride Creek	No designated uses	Flow alteration, sediment, temperature
North Fork Castle Creek	No designated uses	Temperature
Pickett Creek	No designated uses	Sediment
Pickett Creek	No designated uses	Flow alteration, sediment, temperature
Rabbit Creek	No designated uses	Sediment
Reynolds Creek	CW, SS, PCR	Sediment
Sinker Creek	CW,SS, PCR	Flow alteration, sediment, temperature

Water Body	Designated Uses[1]	1998 §303(d) List[2]
South Fork Castle Creek	No designated uses	Bacteria
Squaw Creek	No designated uses	Sediment, temperature
Succor Creek (lower)	CW, SS, PCR	Sediment
Succor Creek (upper)	CW, SS, PCR	Flow alteration, sediment, temperature

[1]CW – Cold Water, SS – Salmonid Spawning, PCR – Primary Contact Recreation, SCR – Secondary Contact Recreation, AWS – Agricultural Water Supply, DWS – Domestic Water Supply

[2]Refers to a list created by the State of Idaho in 1998. Monitoring data was used to identify water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection "d" of the Clean Water Act.
[3]Special Resource Water. A waters designated as a special resource water meets at least one of the following criteria: 1) outstanding quality for recreation and aquatic life; 2) unique ecological significance; 3) outstanding recreational or aesthetic qualities; 4) protection is paramount to the interest of the people in Idaho; 5) within a wild and scenic river system, state or national park system or wildlife refuge; and 6) intensive protection is necessary to maintain an existing, but jeopardized beneficial use.

Table 6. Water Quality Standards Associated with Beneficial Uses

Pollutant & IDAPA Citation	Beneficial Use(s) to Which Standard Applies	Applicable Water Quality Standard
Temperature (58.01.02.250.02.b)	Cold Water Aquatic Life	No greater than 22 degrees Celsius AND no greater than 19 degrees Celsius maximum daily average
(58.01.02.250.02.e.ii)	Salmonid Spawning	During salmonid spawning periods: no greater than 13 degrees Celsius AND no greater than 9 degrees Celsius maximum daily average
Dissolved Oxygen (58.01.02.250.02.a)	Cold Water Aquatic Life Salmonid Spawning	Greater than 6.0 mg/L except in hypolimnion of stratified lakes and reservoirs
Sediment (58.01.02.200.08)	Cold Water Aquatic Life Salmonid Spawning	Sediment shall not exceed quantities specified in general surface water quality criteria (IDAPA 58.01.02.250 or 252) or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses
Turbidity (58.01.02.250.02.d)	Cold Water Aquatic Life	Less than 50 NTU[2] above background for any given sample or less than 25 NTU for more than 10 consecutive days (below any applicable mixing zone set by DEQ)
Bacteria (58.01.02.251.01.b,c)	Contact Recreation	Less than 126 *E. coli* organisms/100 mL as a 30 day geometric mean with a minimum of five samples AND no sample greater than 406 *E. coli* organisms/100 mL

Floating, Suspended, or Submerged Matter (Nuisance Algae) (58.01.02.200.05)	Contact Recreation	Surface waters shall be free from floating, suspended, or submerged matter of any kind in concentration causing nuisance or objectionable conditions or that impair designated beneficial uses and be free from oxygen demanding materials in concentrations that would result in an anaerobic water condition
Excess Nutrients (58.01.02.200.06)	Cold Water Aquatic Life Contact Recreation	Surface waters shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses
pH (58.01.02.250.01.a)	Cold Water Aquatic Life	Hydrogen ion concentration (pH) values within the range of 6.5 to 9.0

[1]NTU = nephlometric turbidity unit

It is DEQ's position that habitat modification and flow alteration, which may adversely affect beneficial uses, are not pollutants under Section 303(d) of the CWA. Idaho has no water quality standards for habitat or flow, nor are they suitable for estimation of load capacity or load allocations. Because of these practical limitations, TMDLs will not be developed to address habitat modification or flow alteration.

Additionally, the CWA states that "TMDLs are required to be established for water bodies impaired by a pollutant, but not by pollution." EPA goes on to say that "EPA does not believe that flow, or lack of flow, is a pollutant as defined by CWA Section 502(6)."

Beneficial Uses

Surface water beneficial use classifications are intended to protect the various uses of the state's surface waters. Idaho water bodies that have designated beneficial uses are listed in the *Idaho Water Quality Standards and Wastewater Treatment Requirements* (IDAPA 58.01.02). They are comprised of five categories: aquatic life, recreation, water supply, wildlife habitat, and aesthetics.

Aquatic life classifications are for water bodies that are suitable or intended to be made suitable for protection and maintenance of viable communities of aquatic organisms. Aquatic life beneficial uses include cold water, warm water, seasonal cold water, modified, and salmonid spawning.

Recreation classifications are for water bodies that are suitable or intended to be made suitable for primary and secondary contact recreation. Primary contact recreation is prolonged and intimate human contact with water where ingestion is likely to occur, such as swimming, water skiing, and skin diving. Secondary contact recreation consists of recreational uses where raw water ingestion is not probable, such as wading and boating.

Water supply classifications are for water bodies that are suitable or intended to be made suitable for agriculture, domestic, and industrial uses. Industrial water supply applies to all waters of the state. Wildlife habitat waters are those that are suitable or intended to be made suitable for wildlife habitat. Aesthetics is a use that applies to all waters of the state.

IDAPA 58.01.02.140 designates beneficial uses for selected water bodies in the Southwest Idaho Basin. Undesignated water bodies are presumed to support cold water biota and primary or secondary contact recreation unless DEQ determines that other uses are appropriate. This is typically done by preparing a detailed evaluation of the attainability of uses in the stream.

Idaho water quality standards require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and "presumed" uses as briefly described in the following paragraphs. The *Water Body Assessment Guidance*, second edition (Grafe et al. 2002) gives a more detailed description of beneficial use identification for use assessment purposes.

Existing Uses

Existing uses under the CWA are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." The existing in-stream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.003.35, .050.02, and 051.01 and .053). Existing uses include uses actually occurring, whether or not the level of quality to fully support the uses exists. Practical application of this concept would be when a water could support salmonid spawning, but salmonid spawning is not yet occurring.

Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho these include things like aquatic life support, recreation in and on the water, domestic water supply, and agricultural use. Water quality must be sufficiently maintained to meet the most sensitive use. Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are specifically listed for water bodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.22 and .100, and IDAPA 58.01.02.109-160 in addition to citations for existing uses).

Presumed Uses

In Idaho, most water bodies listed in the tables of designated uses in the water quality standards do not yet have specific use designations. These undesignated uses are to be designated. In the interim, and absent information on existing uses, DEQ presumes that most waters in the state will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called "presumed uses," DEQ will apply the numeric cold water and primary or secondary contact recreation criteria to undesignated waters. If in addition to these presumed uses, an additional existing use, (e.g., salmonid spawning) exists, because of the requirement to protect levels of water quality for existing uses, then the additional numeric criteria for salmonid spawning would additionally apply (e.g., intergravel dissolved oxygen, temperature). However, if for example, cold water is not found to be an existing use, a use designation to that effect is needed before some other aquatic life criteria (such as seasonal cold) can be applied in lieu of cold water criteria (IDAPA 58.01.02.101.01).

Pollutant Relationships to Beneficial Uses Support Status

This section describes the relationship between the pollutant(s) of concern and the aquatic life or contact recreational beneficial use support status.

Temperature
Temperature is a component of water quality integral to the life cycle of fish and other aquatic species. Different temperature regimes result in varying aquatic community compositions. Water temperature dictates whether a warm, cool, or coldwater aquatic community is present. Many factors, natural and anthropogenic, affect stream temperatures. Natural factors include but are not limited to altitude, aspect, climate, weather, geothermal sources, riparian vegetation (shade), and channel morphology (width and depth). Anthropogenic factors include heated discharges (such as those from point sources), riparian alteration, channel alteration, and flow alteration.

Elevated stream temperatures can be harmful to fish at all life stages, especially if they occur in combination with other habitat limitations such as low dissolved oxygen or poor food supply. Temperature as a chronic stressor to adult fish can result in reduced body weight, reduced oxygen exchange, increased susceptibility to disease, and reduced reproductive capacity. Acutely high temperatures can result in death if they persist for an extended length of time. If stream temperatures become too hot, fish die almost instantaneously due to denaturing of critical enzymes in their bodies (Hogan 1970). The ultimate instantaneous lethal limit occurs in high temperature ranges (> 90 °F). Juvenile fish are even more sensitive to temperature variations than adult fish, and can experience negative impacts at a lower threshold value than the adults, manifesting in retarded growth rates. High temperatures also affect embryonic development of fish before they even emerge from the substrate.

Table 7 shows the different modes of thermally induced mortality on coldwater fish. This data is based on a laboratory study that involved uniform heating of water. Streams, naturally, have varying temperatures and refugia available for fish. Thus, while a stream may have elevated temperatures, these temperatures are not necessarily representative of the entire stream. The redband trout in the Mid Snake River/Succor Creek watershed may be physiologically adapted to higher temperatures and thus, able to withstand higher temperature ranges.

Table 7. Modes of thermally induced coldwater fish mortality (Oregon DEQ 2002).

Modes of Thermally Induced Fish Mortality	Temperature Range
Instantaneous Lethal Limit – Denaturing of bodily enzyme systems	>90° F >32° C
Incipient Lethal Limit – Breakdown of physiological regulation of vital processes, namely respiration and circulation	70° - 77° F 21° - 25° C
Sub-Lethal Limit – Conditions that cause decreased or lack of metabolic energy for feeding, growth, or reproductive behavior; encourage increased exposure to pathogens, decreased food supply, and increased competition from warm water tolerant species	64° - 74° F 17.8° – 23° C

Acceptable temperature ranges vary for different species of fish, with warm water species being the most tolerant of high water temperatures. The salmonid species most commonly found in the Mid Snake River/Succor Creek basin are redband trout in the streams and whitefish in the river. The populations in the streams are generally resident fish and thus, the temperature criteria will be applied on a stream-by-stream basis in order to protect the coldwater aquatic life uses that are present.

The Mid Snake River/Succor Creek watershed has always been typified by high summer air temperatures, high solar radiation, and low stream flows. Heat generally enters the stream through solar radiation, although agricultural return water and artesian wells can also contribute heat to certain streams. Elevated temperatures are exacerbated by human-caused diminished riparian areas and certain management practices, such as flow diversion, but water temperatures may never have been cold during the hottest periods of the year. Native fish have either physiologically adapted to the high temperatures or have been able to find colder water refuge in deep pools and by springs during periods of overall high stream temperatures.

Dissolved Oxygen

Oxygen is necessary for the survival of most aquatic organisms and essential to stream purification. Dissolved oxygen is the concentration of free (not chemically combined) molecular oxygen (a gas) dissolved in water, usually expressed in milligrams per liter (mg/L), parts per million, or percent of saturation. While air contains approximately 20.9 percent oxygen gas by volume, the proportion of DO in air dissolved in water is about 35%, because nitrogen (the remainder) is less soluble in water. Oxygen is considered to be moderately soluble in water. A complex set of physical conditions that include atmospheric and hydrostatic pressure, turbulence, temperature, and salinity affect the solubility.

Dissolved oxygen levels of 6 mg/L and above are considered optimal for aquatic life. When DO levels fall below 6 mg/L, organisms are stressed, and if levels fall below 3 mg/L for a prolonged period, these organisms may die. Dissolved oxygen levels below 1 mg/L are often referred to as hypoxic; oxygen levels that remain below 1-2 mg/L for a few hours can result in large fish kills. Anoxic conditions refer to those situations where there is no measurable DO. Juvenile aquatic organisms are particularly susceptible to the effects of low DO due to their high metabolism and low mobility (they are less able to seek more oxygenated water).

Oxygen is produced during photosynthesis and consumed during plant and animal respiration and decomposition. Oxygen enters water from photosynthesis and from the atmosphere. Where water is more turbulent (i.e., riffles, cascades), the oxygen exchange is greater due to the greater surface area of water coming into contact with the oxygen. The process of oxygen entering the water is called reaeration.

Water bodies with significant aquatic plant communities can have significant DO fluctuations throughout the day. An oxygen sag will typically occur once photosynthesis stops at night and respiration/decomposition processes deplete DO concentrations in the water. Oxygen will start to increase again as photosynthesis resumes with the advent of daylight.

Temperature, flow, nutrient loading, and channel alteration all impact the amount of DO in the water. Colder waters hold more DO than warmer waters. As flows decrease, the amount of reaeration typically decreases and the instream temperature increases, resulting in decreased DO. Channels that have been altered to increase the effectiveness of conveying water often have less riffle or reaeration. Thus, these systems may show depressed levels of DO in comparison to levels before the alteration. Nutrient enriched waters can have a higher biochemical oxygen demand due to the amount of oxygen required for organic matter decomposition and other chemical reactions. This oxygen demand results in lower instream DO levels.

Sediment

Both suspended and bedload sediment (sediment particles too large or heavy to be suspended, but still transported by flowing water) can have negative effects on aquatic life communities. Many fish species can tolerate elevated suspended sediment levels for short periods of time, such as during natural spring runoff, but longer durations of exposure are detrimental. Elevated suspended sediment levels can interfere with feeding behavior (difficulty finding food due to visual impairment), damage gills, reduce growth rates, smother eggs and fry in the substrate, damage habitat, and in extreme cases eventually lead to death. Eggs, fry, and juveniles are especially sensitive to suspended sediment.

Newcombe and Jensen (1996) reported the effects of suspended sediment on fish, summarizing 80 published reports on suspended sediments in streams and estuaries. For rainbow trout, physiological stress, which includes reduced feeding rate, is evident at concentrations of 50 to 100 mg/L when those concentrations are maintained for 14 to 60 days. Similar effects are observed for other species, although the data set is less reliable. Adverse effects on habitat, especially spawning and rearing habitat, were noted at similar concentrations.

Bedload sediment also adversely affects aquatic species. As sand and silt wash downstream, they can cover spawning gravels, increasing embeddedness in the streambed. If this occurs during incubation periods or while small fry are using the spawning gravels to develop, it may eliminate those areas and result in death. Bedload can also reduce intergravel DO levels by decreasing the critical re-oxygenating flow through the intergravel matrix. Organic suspended sediments can also settle to the bottom and, due to their high carbon content, lead to low intergravel DO.

In addition to these direct effects on the habitat and spawning success of fish, detrimental food source changes may also occur. Aquatic insects, which serve as a primary food source for fish, are affected by excess sedimentation. Increased sedimentation leads to a macroinvertebrate community that is prone to burrowing, thereby making the macroinvertebrates less available to fish. Community structure, specifically diversity, of the aquatic macroinvertebrate community also diminishes due to the reduction of coarse substrate habitat.

Water column sediment levels in the Snake River, Reynolds Creek, Jump Creek, Succor Creek, and Birch Creek have been measured through the collection of total suspended solids (TSS) and/or suspended sediment concentration (SSC) samples. Suspended sediment concentration is determined by measuring the dry weight of all the sediment from a known volume of a water-sediment mixture. The terms SSC and TSS are often confused in the literature and are frequently used interchangeably. However, the results may be considerably different if a substantial amount of sand-sized material comprises the sample. Mid Snake River monitoring data collected in 2002 show a close correlation between TSS and SSC data (r^2=.94, N=32) both year round and during the irrigation season, meaning that the samples are not dominated by sand-sized particles.

Settleable solids are defined as the volume (milliliters [mL]) or weight (mg) of material that settles out of a liter of water in one hour (Standard Methods 1985). In the Snake River, settleable solids consist primarily of large silt, sand, and organic matter. Total suspended solids are defined as the material collected by filtration through a 0.45 µm (micrometer) filter (Standard Methods 1985). The primary forms of TSS in the Snake River are silt, clay, and phytoplankton. Settleable solids and TSS both contain nutrients that are essential for aquatic plant growth. Settleable solids are not as nutrient rich as the smaller TSS, but they do affect river depth and substrate nutrient availability for macrophytes. In low flow situations, settleable solids accumulate on the Snake River bottom, thus decreasing water depth. This increases the area of substrate that is exposed to light, facilitating additional macrophyte growth.

Sediments originating from the drainage basin are primarily inorganic, have a low carbon content, have high densities, and often increase in the water column during runoff events. Sediments originating instream (from primary production) are organic with a higher carbon content and lower density and often increase in association with algal blooms. The concentration of organic sediments can be underestimated because of their lower density.

Total suspended solids not only result in excess nutrients in the water column through nutrient spiraling, but also directly affect the turbidity of water. The potential to increase primary production as well as the direct effect on reducing cold water aquatic life habitat are the major concerns with sediment in aquatic systems in the Mid Snake River/Succor Creek watershed.

Bacteria
Coliform bacteria are unicellular organisms found in feces of warm-blooded animals such as humans, domestic pets, livestock, and wildlife. Coliform bacteria are commonly monitored as part of point source discharge permits (National Pollution Discharge Elimination System [NPDES] permits), but may also be monitored in nonpoint source arenas. The human health effects from pathogenic coliform bacteria range from nausea, vomiting, diarrhea, acute respiratory illness, meningitis, ulceration of the intestines, and even death. Coliform bacteria do not have a known effect on aquatic life.

Coliform bacteria from both point and nonpoint sources impact water bodies, although point sources are typically permitted and offer some level of bacteria-reducing treatment prior to discharge. Nonpoint sources of bacteria are diffuse and difficult to characterize. Unfortunately, nonpoint sources often have the greatest impact on bacteria concentrations in water bodies. This is particularly the case in urban stormwater, agricultural areas and where wildlife is abundant. Wildlife may account for a significant percentage of the bacteria in some water bodies, although the exact percentage is difficult to determine.

Floating, Suspended, or Submerged Matter (Nuisance Algae)
Algae are an important part of the aquatic food chain. However, when elevated levels of algae impact beneficial uses, those levels are considered nuisance aquatic growth. The excess growth of phytoplankton, periphyton, and/or macrophytes can adversely affect both aquatic life and recreational water uses. Algal blooms occur where adequate nutrients (nitrogen and/or phosphorus) are available to support growth. In addition to nutrient availability, flow-rates, velocities, water temperatures, and penetration of sunlight in the water column all affect algae (and macrophyte) growth. Low velocity conditions allow algal concentrations to increase because physical removal by scouring and abrasion does not readily occur. Increases in temperature and sunlight penetration also result in increased algal growth. When the aforementioned conditions are appropriate and nutrient concentrations exceed the quantities needed to support algal growth, excessive blooms may develop.

Algae blooms commonly appear as extensive layers or algal mats on the surface of the water. When present at excessive concentrations in the water column, blue-green algae often produce toxins that can result in skin irritation to swimmers, and illness or even death in organisms ingesting the water. The toxic effect of blue-green algae is worse when an abundance of organisms die and accumulate in a central area. Two canine deaths due to ingestion of blue-green algal toxins were confirmed in November 2000 and several others suspected in fall of 1999 below the Minidoka Dam along the Snake River between Rupert and Burley (Eyre 2001).

Algal blooms also often create objectionable odors and coloration in water used for domestic drinking water, and can produce intense coloration of both the water and shorelines as cells accumulate along the banks. In extreme cases, algal blooms can also result in impairment of agricultural water supplies due to toxicity. Water bodies with high nutrient concentrations that could potentially lead to a high level of algal growth are said to be eutrophic. The extent of the effect is dependent on both the type(s) of algae present and the size, extent, and timing of the bloom.

When algae die in low flow velocity areas, they sink slowly through the water column, eventually collecting on the bottom sediments. The biochemical processes that occur as the algae decompose remove oxygen from the surrounding water. Because most of the decomposition occurs within the lower levels of the water column, a large algal bloom can substantially deplete DO concentrations near the bottom. Low DO in these areas can lead to decreased fish habitat as fish will not frequent areas with low DO. Both living and dead (decomposing) algae can also affect the pH of the water due to the release of various acid and base compounds during respiration and photosynthesis. Additionally, low DO levels caused by decomposing organic matter can lead to changes in water chemistry and release of sorbed phosphorus to the water column at the water/sediment interface.

Excess nutrient loading can be a water quality problem due to the direct relationship of high total phosphorus (TP) concentrations on excess algal growth within the water column, combined with the direct effect of the algal life cycle on DO and pH within aquatic systems. Therefore, the reduction of TP inputs to the system can act as a mechanism for water quality improvements, particularly in surface-water systems dominated by blue-green algae, which can acquire nitrogen directly from the atmosphere and the water column. Phosphorus management within these systems can potentially result in improvement in the following water quality parameters: nutrients (phosphorus), nuisance algae, DO, and pH.

Excess Nutrients

This discussion on nutrients focuses on the dynamics of nutrients in the Snake River because it is the only water body listed for nutrients in the watershed. However, practically speaking, the discussion would also be applicable to nutrient-enriched tributaries.

The principle nutrients limiting aquatic plant growth in the Snake River are nitrogen and total phosphorus. While nutrients are a natural component of the aquatic ecosystem, natural cycles can be disrupted by increased nutrient inputs from anthropogenic activities. The excess nutrients result in accelerated plant growth and can result in a eutrophic or enriched system. The nuisance aquatic growth caused by this enrichment is discussed in the following section.

The first step in identifying a water body's response to nutrient flux is to define which of the critical nutrients is limiting. A limiting nutrient is one that normally is in short supply relative to biological needs. The relative quantity affects the rate of production of aquatic biomass. Either nutrient (phosphorus or nitrogen) may be the limiting factor for algal growth, although phosphorous is most commonly the limiting nutrient in Idaho waters.

Ecologically speaking, a resource is considered limiting if the addition of that resource increases growth (DEQ 1999).

The *Upper Snake Rock Subbasin Assessment and TMDL* (DEQ 2000) and the *Snake River-Hells Canyon TMDL* (DEQ 2001) determined that TP is the primary limiting nutrient in the free flowing areas of the Snake River. Total phosphorus is the measurement of all forms of phosphorus in a water sample, including all inorganic and organic particulate and soluble forms. In freshwater systems, typically greater than 90% of the TP present occurs in organic forms as cellular constituents in the biota or adsorbed to particulate materials (Wetzel 1983). The remainder of phosphorus is mainly soluble orthophosphate, a more biologically available form of phosphorus that consequently leads to a more rapid growth of algae than TP. Chapter 5 discusses the selection of TP as a water quality target over orthophosphate. In impaired systems, a larger percentage of the TP fraction is comprised of orthophosphate. The relative amount of each form measured can provide information on the potential for algal growth within the system.

Nitrogen may be a limiting factor at certain times if there is substantial depletion of nitrogen in sediments due to uptake by rooted macrophyte beds. In systems dominated by blue-green algae, nitrogen is not a limiting nutrient due to the algal ability to fix nitrogen at the water/air interface.

Total nitrogen to TP ratios (N:P) in the Mid Snake River/Succor Creek reach of the Snake River showed that phosphorus was the limiting nutrient the majority of the time (DEQ 1993, 2002). Nutrient data from the riverine sections of the Snake River Hells Canyon and the Mid Snake/Rock Creek watershed also show similar findings (DEQ 2001, 2000). Total nitrogen to TP ratios greater than seven are indicative of a phosphorus-limited system while those ratios less than seven are indicative of a nitrogen-limited system. Only biologically available forms of the nutrients are used in the ratios because these are the forms that are used by the immediate aquatic community.

Nutrients primarily cycle between the water column and sediment through nutrient spiraling. Aquatic plants rapidly assimilate dissolved nutrients, particularly orthophosphate. If sufficient nutrients are available in either the sediments or the water column, aquatic plants will store an abundance of such nutrients in excess of the plants' actual need, a chemical phenomenon known as luxury consumption. When a plant dies, the tissue decays in the water column and the nutrients stored within the plant biomass are either restored to the water column or the detritus becomes incorporated into the river sediment. As a result of this process, nutrients (including orthophosphate) that are initially released into the water column in a dissolved form will eventually become incorporated into the river bottom sediment. Once these nutrients are incorporated into the river sediment, they are available once again for uptake by yet another life cycle of rooted aquatic macrophytes and other aquatic plants. This cycle is known as nutrient spiraling.

Nutrient spiraling results in the availability of nutrients for later plant growth in higher concentrations downstream. Nutrient concentrations in the Snake River have caused nuisance aquatic growths impairing designated or protected beneficial uses. As a result, nutrient concentrations in the Snake River exceed the present assimilative capacity.

Sediment – Nutrient Relationship
The linkage between sediment and sediment-bound nutrients is important when dealing with nutrient enrichment problems in aquatic systems. Phosphorus is typically bound to particulate matter in aquatic systems and, thus, sediment can be a major source of phosphorus to rooted macrophytes and the water column. While most aquatic plants are able to absorb nutrients over the entire plant surface due to a thin cuticle (Denny 1980), bottom sediments serve as the primary nutrient source for most sub-stratum attached macrophytes. The USDA (1999) determined that other than harvesting and chemical treatment, the best and most efficient method of controlling growth is by reducing surface erosion and sedimentation.

Sediment acts as a nutrient sink under aerobic conditions. However, when conditions become anoxic, sediments can release phosphorous into the water column. Nitrogen can also be released, but the mechanism by which this happens is different. The exchange of nitrogen between sediment and the water column is for the most part a microbial process controlled by the amount of oxygen in the sediment. When conditions become anaerobic, the oxygenation of ammonia (nitrification) ceases and an abundance of ammonia is produced. This results in a reduction of nitrogen oxides (NO_x) being lost to the atmosphere.

Sediments can play an integral role in reducing the frequency and duration of phytoplankton blooms in standing waters and large rivers (Robertson 1999). In many cases there is an immediate response in phytoplankton biomass when external sources are reduced. In other cases, the response time is slower, often taking years. Nonetheless, the relationship is important and must be addressed in waters where phytoplankton is in excess.

2.3 Summary and Analysis of Existing Water Quality Data

The amount of available data varied substantially between subwatersheds. Types of available data also ranged widely, but typically represent biological, chemical, and physical parameters. Data pertinent to the water quality issues being addressed are presented for each listed stream in this section.

Data Assessment Methods

Several primary methods were used to evaluate the data for this subbasin assessment. A detailed description of the primary methods is located in Appendix G. A brief description of each method is located below.

DEQ-Water Body Assessment Guidance – Second Edition (Grafe et al. 2002)
The Water Body Assessment Guidance (WBAG) describes DEQ's methods used to consistently evaluate data and determine the beneficial use support status of Idaho water bodies. The WBAG is not used to determine pollutant-specific impairment. Rather, it utilizes a multi-index approach to determine overall stream support status. The methodology addresses many reporting requirements of state and federal rules, regulations, and policies.

For the most part, DEQ Beneficial Use Reconnaissance Program (BURP) data is used in the assessment. However, where available, other data is integrated into the assessment process.

An assessment entails analyzing and integrating multiple types of water body data such as biological, physical/chemical, and landscape data to address multiple objectives. The objectives are:

1. Determine beneficial use support status of the water body (i.e., fully supporting versus not fully supporting).
2. Determine biological integrity using biological information or other measures.
3. Compile descriptive information about the water body and data used in the assessment.

The multi-metric index approach measures biological, physiochemical, and physical habitat conditions within a stream. The indexes include several characteristics to gauge overall stream health. Three primary indexes are used, which include the Stream Macroinvertebrate Index (SMI), the Stream Fish Index (SFI) and the Stream Habitat Index (SHI). The SMI is a direct measure of cold water aquatic life health. The SFI is also a direct measure of cold water aquatic life health, but is specific to fish populations. The SHI is used to measure instream habitat suitability, although some of the measurements used to generate the SHI are linked to the riparian area.

Stream Segment Temperature Model (SSTEMP)
Changes in stream temperature as a result of riparian shading and channel shape are being assessed using SSTEMP (Bartholow 1999). These changes in stream temperature are linked to restoring cold water aquatic life beneficial uses, including salmonid spawning, which in many cases is impaired due to elevated stream temperatures.

The SSTEMP model is a one-dimensional steady-state stream temperature model that can be used to evaluate the effects of riparian shade, channel width, and stream flow on stream temperature in individual stream segments. The model calculates the heat gained or lost in a water body as it passes through a defined stream segment. The model is capable of predicting the decrease in instream temperature as a result of a specified increase in stream shade. The program predicts the minimum, mean, and maximum daily water temperatures at a specified distance downstream.

For streams listed for temperature, the pollutant is heat. The primary source of heat is solar radiation reaching the stream surface, although other sources (such as geothermal wells) are certainly considered. Streams that have increased width/depth ratios and decreased riparian shading are more susceptible to elevated stream temperatures.

To address the loading portion of the TMDL, heat (joules/m^2) is used to calculate loading capacities. Riparian shade, and to a lesser degree width/depth, are used as surrogates for excess solar radiation (heat). Thus, loading reductions are expressed in terms of heat, increased shading, and, to a lesser degree, decreased width/depth.

Stream Bank Erosion Inventory
The stream bank inventory was used to estimate background and existing stream bank and channel erosion. The inventory follows methods outlined in the proceedings from the National Resource Conservation Service (NRCS) Channel Evaluation Workshop (1983). The NRCS stream bank erosion inventory is a field-based method that measures bank and channel characteristics such as stability, length of eroding banks, and depth of eroding banks to calculate a long-term lateral recession rate. The recession rate is expressed in terms of the feet of stream bank lost due to erosion per year (ft/year). The lateral recession rate can then be combined with the volumetric mass of the bank material and the length of the segment to determine the sediment load from the stream banks.

The stream bank erosion inventories are linked to bank stability, which is used as a surrogate for instream channel particle size distributions. Previous TMDLs (DEQ 2001a, 2001b) have established a linkage between 80% streambank stability and less than 28% fine substrate material in riffles. This linkage allows for the restoration of beneficial uses to be assessed based on bank stability (i.e. streams with >80% bank stability will likely support cold water aquatic life beneficial uses). Of course, this linkage is based on sediment related use impairment only. If factors other than excess sediment are impairing uses, this method will not detect them and they must be addressed elsewhere.

For the Mid Snake River/Succor Creek TMDL, DEQ staff measured the stream bank erosion rates of areas where banks are greater than 80% stable. These areas are used as reference reaches for similar morphological channel types on the same stream where banks are eroding. The lateral recession rate from the reference reach becomes the benchmark for the remainder of the listed reach and thus, is the basis of load reductions.

Evaluations of Intermittence for Selected Streams
The state of Idaho defines an intermittent stream as one that has a period of zero flow for at least one week during most years or has a 7Q2 (a measure of the annual minimum 7-day mean stream flow, based on either a 2 year low) hydrologically based flow of less than 0.10 cfs (IDAPA 58.01.02.003.51). If a stream contains naturally perennial pools with significant aquatic life, it is not considered intermittent. Using this definition as guidance, DEQ identified eight §303(d) listed intermittent streams, as shown in Table 8. Appendix E provides a detailed analysis showing why each stream was determined to be intermittent. The implication of this determination is that a TMDL will not be performed for these streams because water is not present during the critical loading period (typically the irrigation season) or when aquatic life beneficial uses are absolutely expected to be fully supported (middle to late summer months). IDAPA 58.01.02.070.07 states that water quality standards shall only apply to intermittent waters during optimum flow periods sufficient enough to support the beneficial uses for which the water body has been designated. The optimum flow for contact recreation is equal to or greater than 5.0 cfs. The optimum flow for aquatic life is equal to or greater than 1.0 cfs.

Table 8. §303(d) listed intermittent streams in the Mid Snake River/Succor Creek Subbasin.

Water Body	§303(d) Listed Boundaries
McBride Creek	Headwaters to Oregon Line
Corder Creek	Headwaters to Snake River
Rabbit Creek	Headwaters to Snake River
Brown Creek	Headwaters to Catherine Creek
Hardtrigger Creek	Headwaters to Snake River
Birch Creek	Headwaters to Snake River
Pickett Creek	Headwaters to Catherine Creek
Poison Creek	Headwaters to Shoofly Creek

Evaluations of Spawning Conditions for Selected Streams
In comparing the §303(d) list for the Mid Snake River/Succor Creek watershed with the designated beneficial uses for each stream, DEQ has identified four stream segments that contain misleading salmonid spawning beneficial use designations. The stream segments are on the lower ends of Castle, Sinker, Reynolds, and Succor Creeks (but do not include the entire stream). The hydrologic regime, temperature regime, and gradient of each of these lower segments is such that they are most likely migration corridors for spawning activity that occurs further up in the stream.

While there is certainly a water quality component that must be addressed if necessary, the use of a stream by fish for spawning is also a local habitat issue. Fish rarely spawn throughout an entire stream. Rather, they choose locations that have ample spawning gravels, suitable water temperatures, and good habitat/cover for juvenile rearing. State-specific water quality criteria or targets for salmonid spawning will apply to those areas of the tributaries designated for salmonid spawning **and** where spawning actually occurs or could occur under restored conditions. Therefore, while it is critical to protect spawning habitat in the tributaries, and the designation will remain, it is not assumed to occur in the entire designated reach. Idaho Department of Fish and Game, in conjunction with DEQ, has closely examined the four stream segments listed above and has determined that while they are designated for spawning, in all likelihood it does not occur in those areas and should not be considered an achievable use in this assessment. Appendix F summarizes the position of DEQ and IDFG.

Snake River

This section describes the physical, chemical and biological data for the listed segments of the Snake River.

Hydrology
As illustrated in Figures 2.0-2.2, the Snake River is a large volume river (USGS 2002). Regulated by dams and irrigation withdrawals, the Snake River flows peak in late spring and then drop substantially in late June (Figure 2.1). In addition to receiving water from tributaries within the watershed, the Snake River also receives irrigation return water from the Owyhee Reservoir and the Boise Project. An important consideration in reviewing the water budget is that water in the drains is often partially derived from Snake River water that had been previously pumped out of the river. However, the tributaries and other agricultural related inputs represent only a small percentage of the river flow. In 1985 minimum flow requirements were implemented at Swan Falls Dam. The minimum flow requirement from April 1-October 31 is 3,900 cfs while from November 1- March 31, the minimum flow requirement is 5,600 cfs (Figure 2.2).

The greatest contribution of flow to this reach comes from the upstream stretch of the Snake River above CJ Strike Dam. Tributary and drain flow contributions vary from year to year but are generally 10% or less of the total measured volume. However, in terms of pollutant loading, the tributaries and drains can be significant sources of TP. The TP concentrations in the tributaries and drains are typically five to six times greater than the instream target of 0.07 mg/L. Ground water inflows appear to contribute an insignificant amount to instream volume (Idaho Power 1998, DEQ 1978).

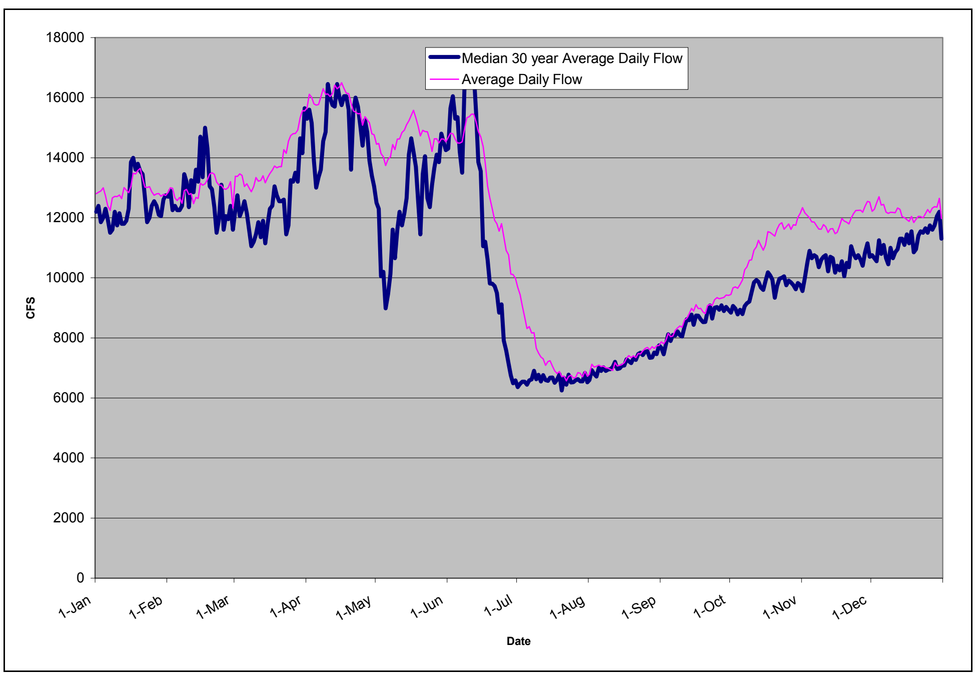

Figure 2.0 Snake River at Murphy 30 Year Average Flows

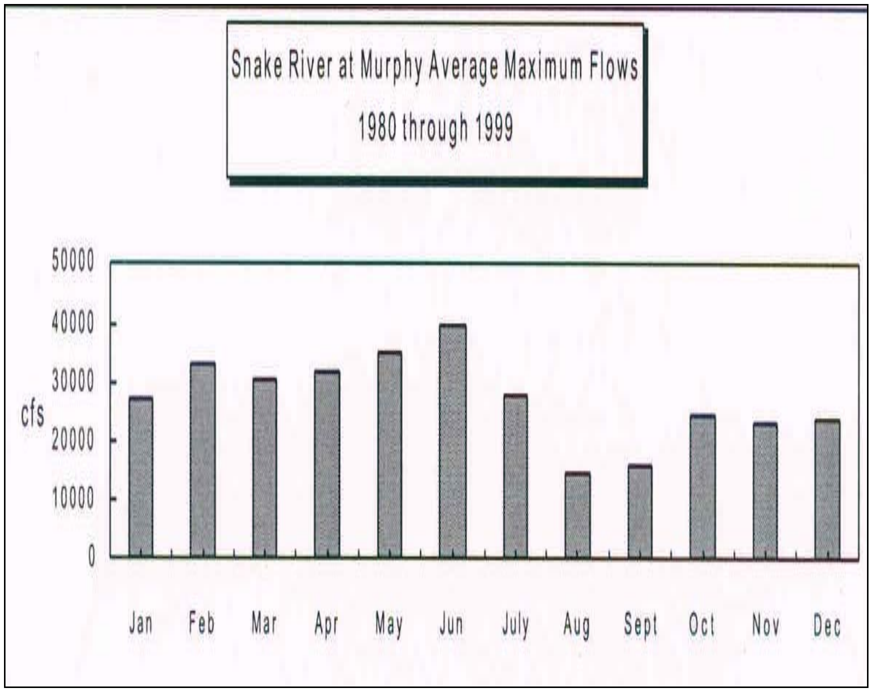

Figure 2.1 Snake River at Murphy Average Maximum Flows, 1980-1999

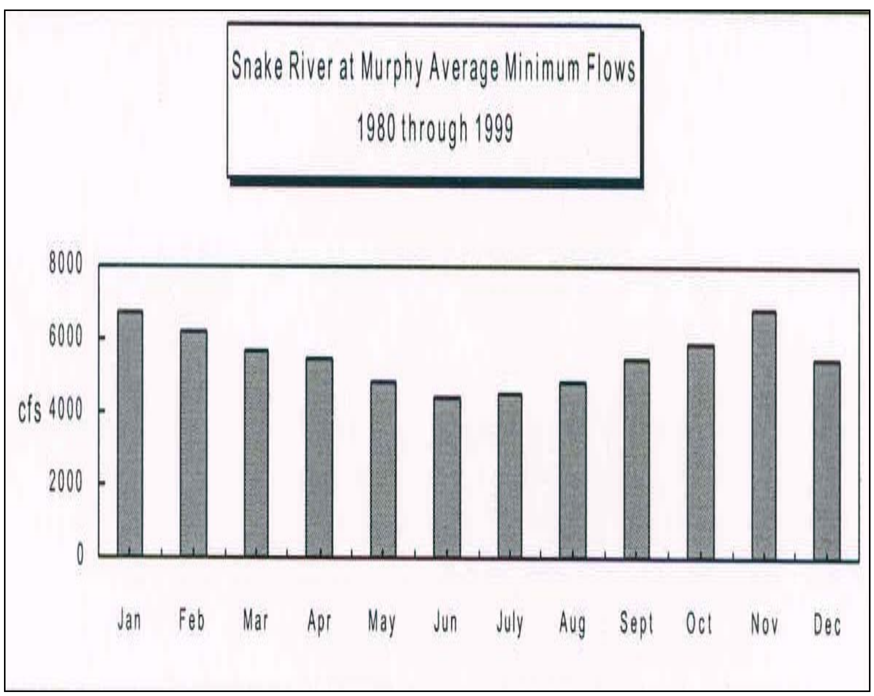

Figure 2.2 Snake River at Murphy Average Minimum Flows, 1980-1999

Bacteria
DEQ monitored *E. Coli* bacteria weekly in July and August 2002 in order to calculate a monthly geometric mean. Five samples were collected at least three days apart in a 30-day period and the geometric mean was then calculated. Samples were taken at the following locations: SR001, SR002, SR at Walters Ferry, SR004, and SR005, as shown in Figure 2.3. Samples were taken at recreational access points (i.e., boat ramps, docks) wherever possible. At SR002, samples were taken from a bridge. As shown in Table 9, none of the monitoring sites exceeded the geometric mean standard of 126 organisms/100mL for either primary or secondary contact recreation. Hence, the Snake River will be proposed for de-listing of bacteria.

Table 9. Geometric Mean of *E. coli* (counts/100 mL), summer 2002.

SR001[1]	SR002	SR at Walters Ferry	SR004	SR005
9.9	6.46	3.52	7.2	35.21

[1]See Figure 2.3 for the specific location of each monitoring location.

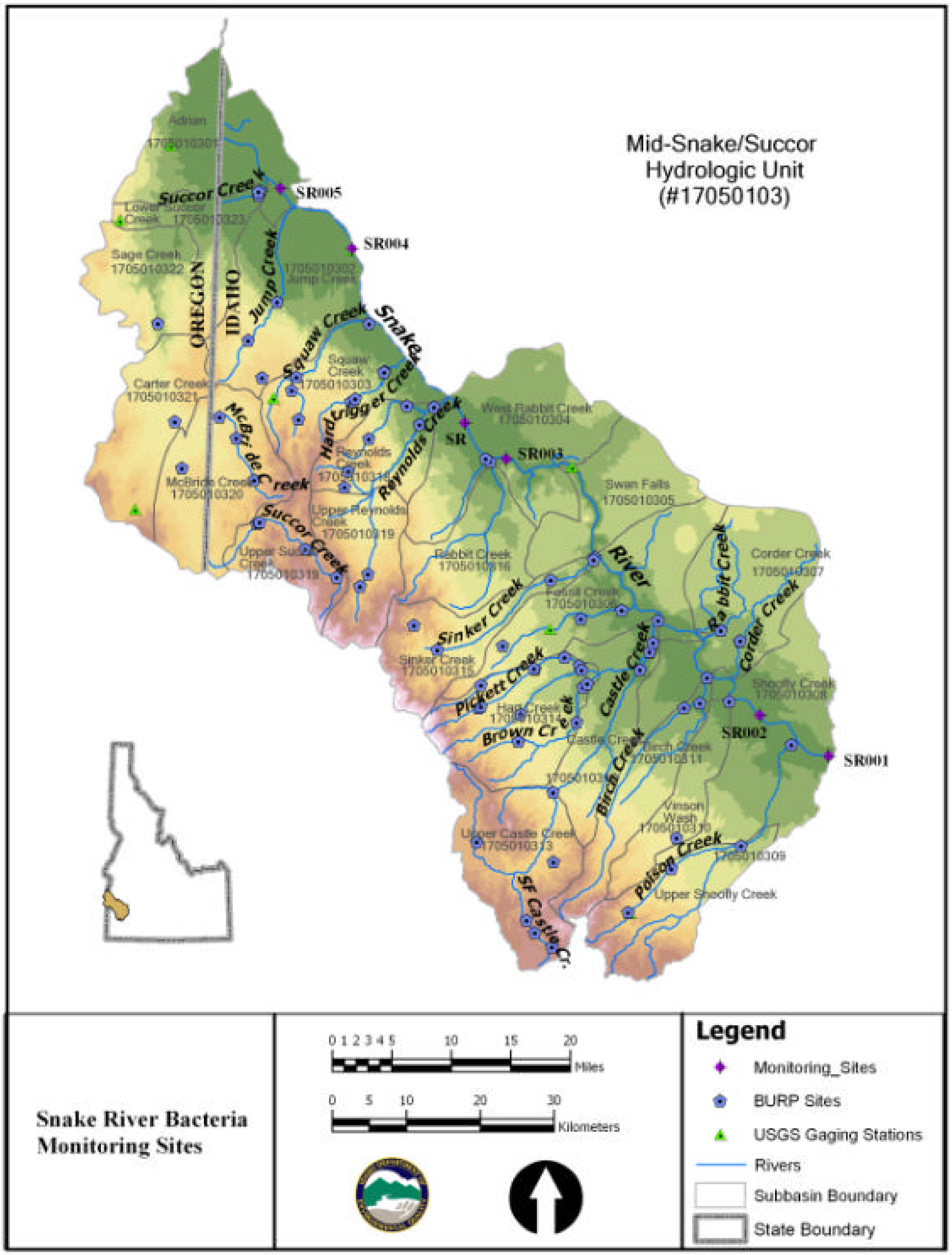

Figure 2.3 Snake River Bacteria Monitoring Sites

Temperature
The Snake River is designated for cold water aquatic life, but supports a primarily warm and cool water fishery. Elevated temperatures above the cold water aquatic life temperature standard are typically observed in July and August. The maximum weekly average temperature during the first week of August 1997 was 23 °C.

Figure 2.4 July 14, 2002: Fish kill on the Snake River at Walters Ferry

In 1992, a drought year, an instantaneous maximum of 29 °C was reached downstream of Swan Falls Dam. In early July 2002, following several days of extremely hot weather, instantaneous temperatures exceeded 26 °C below Swan Falls Dam. These temperatures resulted in a large fish kill of mountain whitefish (Figure 2.4). This event occurred after several days of extremely hot weather and water temperatures >26 degrees Celsius. This picture is not meant to imply that these fish kills occur on an annual basis, nor is it necessarily representative of conditions in the tributaries to the Snake River. Whitefish are subject to lethal effects at temperatures above 26 °C. An Idaho Power study on the habitat of the Snake River Plain states that whitefish kills are common in the Swan Falls area in the summer and are primarily due to elevated temperatures. (IPC 2002)

As shown in Figure 2.5, the Snake River exceeds the cold water maximum daily average temperature of 19 °C (USGS 2000). The Snake River is proposed for temperature listing on the §303(d) list. A TMDL is not being written at this time in order to allow time to adequately assess the thermal site potential of the river.

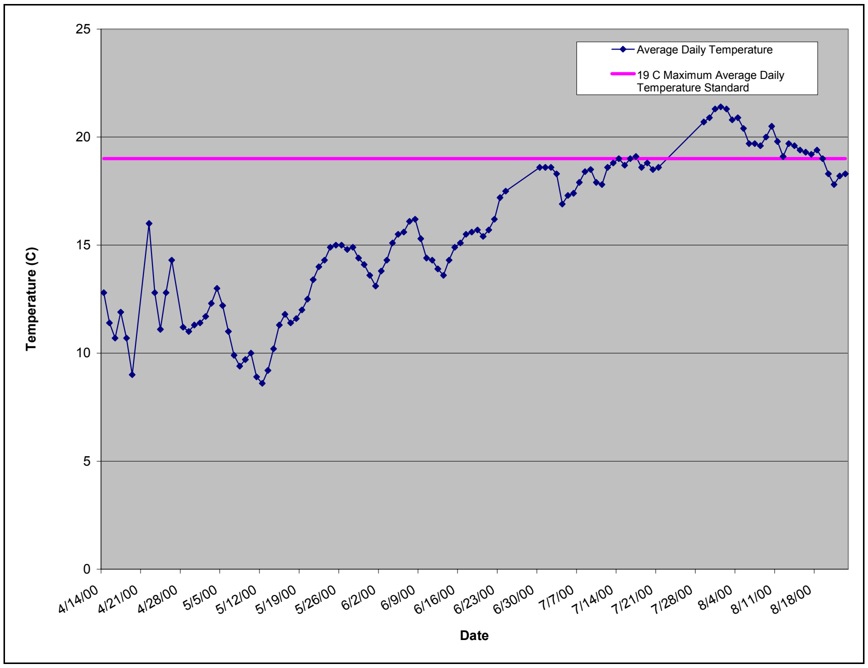

Figure 2.5 Snake River near Murphy Average Daily Temperature in 2000

pH

pH data collected from 1968 to 1974 showed pH levels between 7.7 and 8.5 slightly upstream from river mile 409 (near Marsing). These data were collected over a variety of seasons, but do not represent continuous monitoring (USEPA 1974,1975). Data collected from 1975 to 1991 show pH values from 7.5 to 8.9. Again, these data were collected over a variety of seasons, but do not represent continuous monitoring.

As shown in Figure 2.6, 1995 data from Idaho Power show pH values from 7.7 to 8.77. These values are similar to the data collected previously. These data are from sampling locations at Celebration Park, Marsing, and Homedale. Data collected from the CJ Strike Tailrace from 1993 to 1995 showed pH values ranging from 7.7 to 8.9 (IPC 1998).

The available data show that pH values remain within the standard range of 6.5 – 9. Thus, DEQ recommends that the mainstem Snake River from Swan Falls to the Idaho/Oregon border be delisted for pH. However, because pH values are often high in the summertime, corresponding to periods with algal blooms, further monitoring of pH should continue to be an integral part of the water quality monitoring regime. Decreases in nutrient loads should result in decreases in pH.

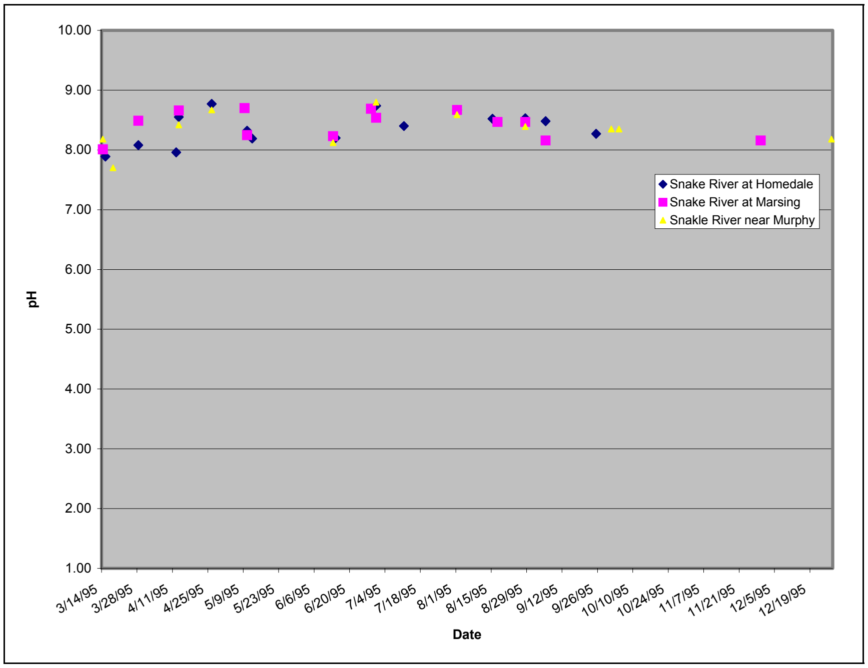

Figure 2.6. Mid Snake River pH Results

Sediment
Both TSS and SSC have been monitored in the Snake River. As shown in Figures 2.7 through 2.10 and Table 10, except during spring runoff, instream concentrations are generally below the 50 mg/L target set in the SR-HC TMDL.

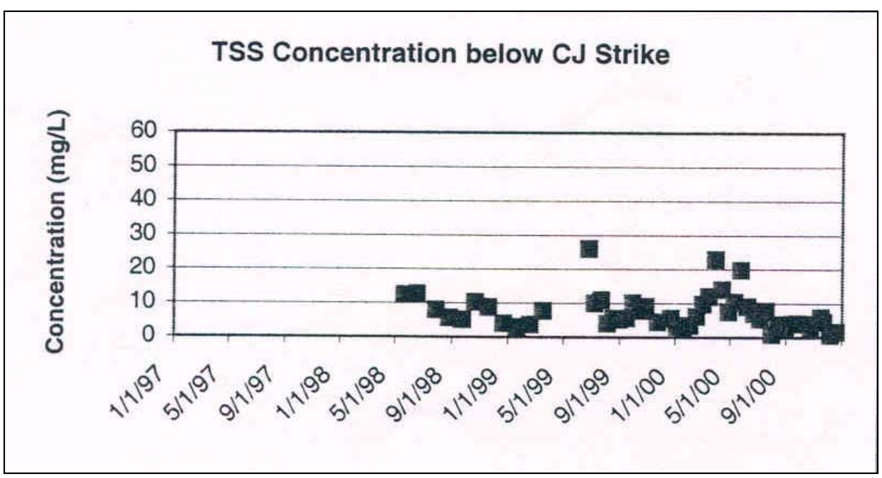

Figure 2.7 Total Suspended Solids Concentrations, Snake River below CJ Strike Dam (IPC 2002)

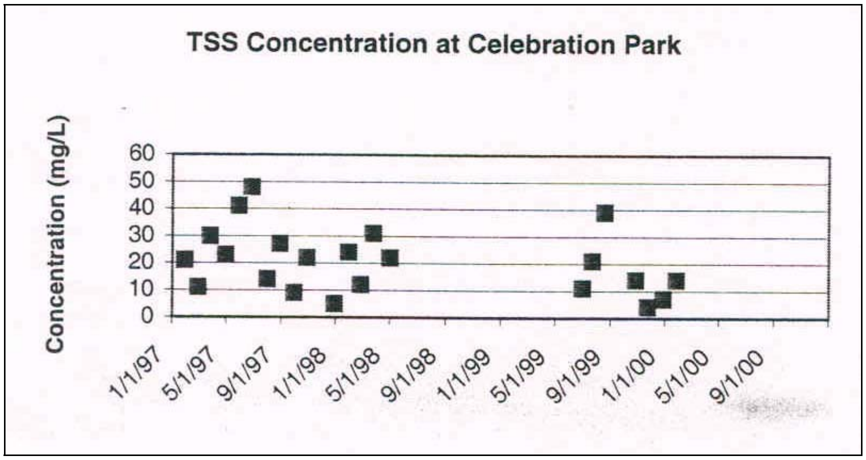

Figure 2.8 Total Suspended Solids Concentrations, Snake River at Celebration Park (IPC 2002)

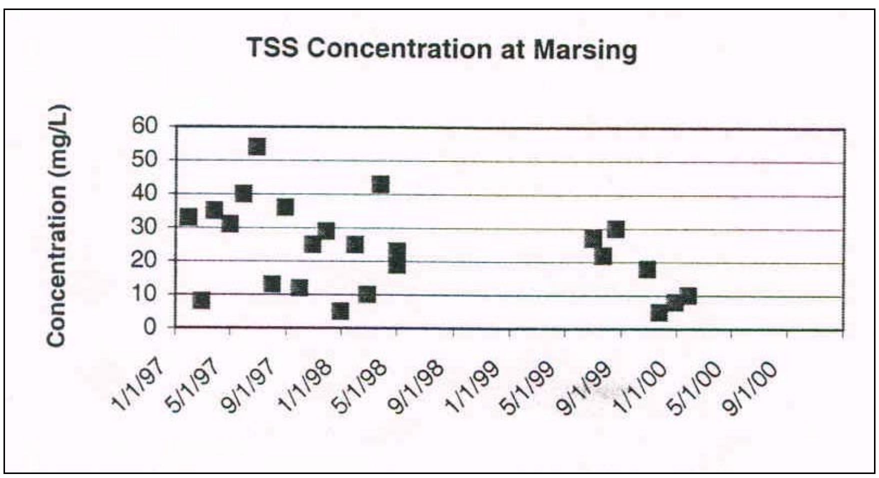

Figure 2.9 Total Suspended Solids Concentrations, Snake River at Marsing (IPC 2002)

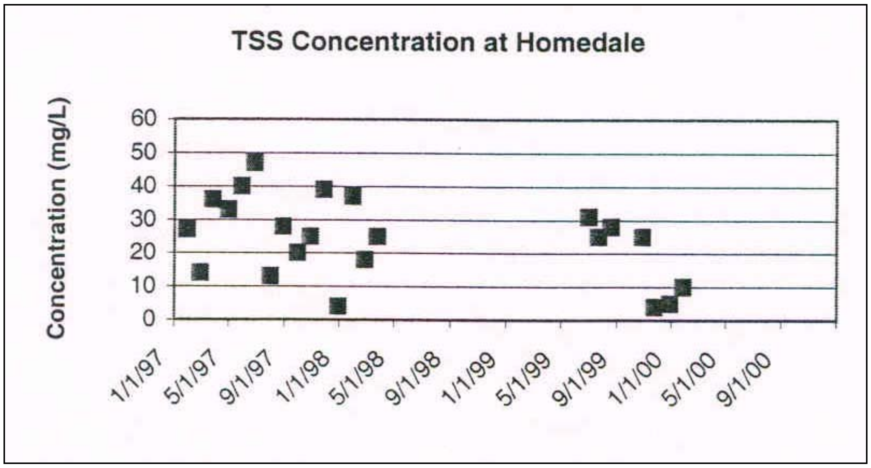

Figure 2.10 Total Suspended Solids Concentrations, Snake River at Homedale (IPC 2002)

Table 10. Snake River total suspended solids (TSS) sample average.

Sample Site	Number of Samples	Average TSS Concentration (mg/L)
Snake River at Marsing	88	21

DEQ monitored both SSC and TSS and found a .94 coefficient or determination (R^2) both annually and during the irrigation season. This finding suggests that the suspended sediment samples are made primarily of silt material and not dominated by sand-sized or larger particles. Thus, the 50 mg/L target for SSC can be applied to TSS data.

The sediment data outlined above indicate that water column sediment is not impairing beneficial uses. Thus, DEQ recommends that the mainstem Snake River from CJ Strike to the Idaho/Oregon border be delisted for sediment.

Total Dissolved Gas (TDG)

Elevated TDG levels above 110% saturation are known to have a detrimental effect on aquatic life. High concentrations of gas in the water can result in gas bubble trauma. This condition occurs when air bubbles form in the circulatory systems of fish. The mechanism for formation is when the dissolved gas pressure exceeds the compensating pressures of blood, tissue, water surface, and hydrostatic head tension.

Idaho has numeric water quality standards for TDG. The concentration of TDG relative to atmospheric pressure at the point of sample collection shall not exceed 110% saturation except when stream flow exceeds the ten-year, seven-day average flood. The target concentration for this TMDL is 110% saturation or less.

As shown in Figure 2.11, when water is spilling at a rate greater than 600 cfs at CJ Strike Dam, total dissolved gas (TDG) levels exceed 110% saturation (IPC 2002). Total dissolved gases at Swan Falls Dam also exceed the standard when water is spilled over the spillway, as shown in Figure 2.12.

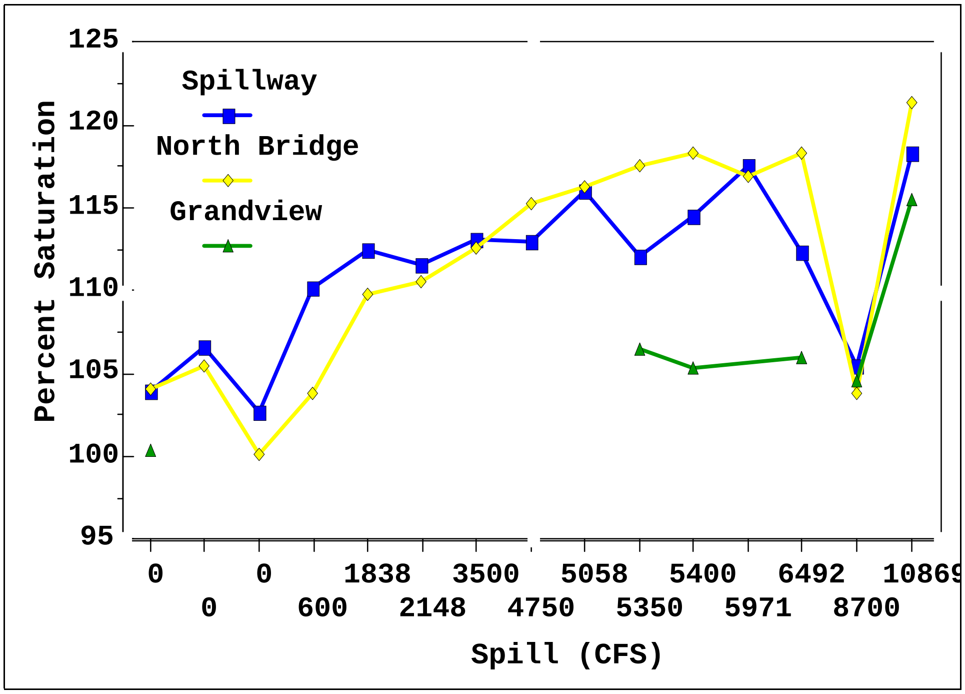

Figure 2.11 Total Dissolved Gasses at CJ Strike Dam

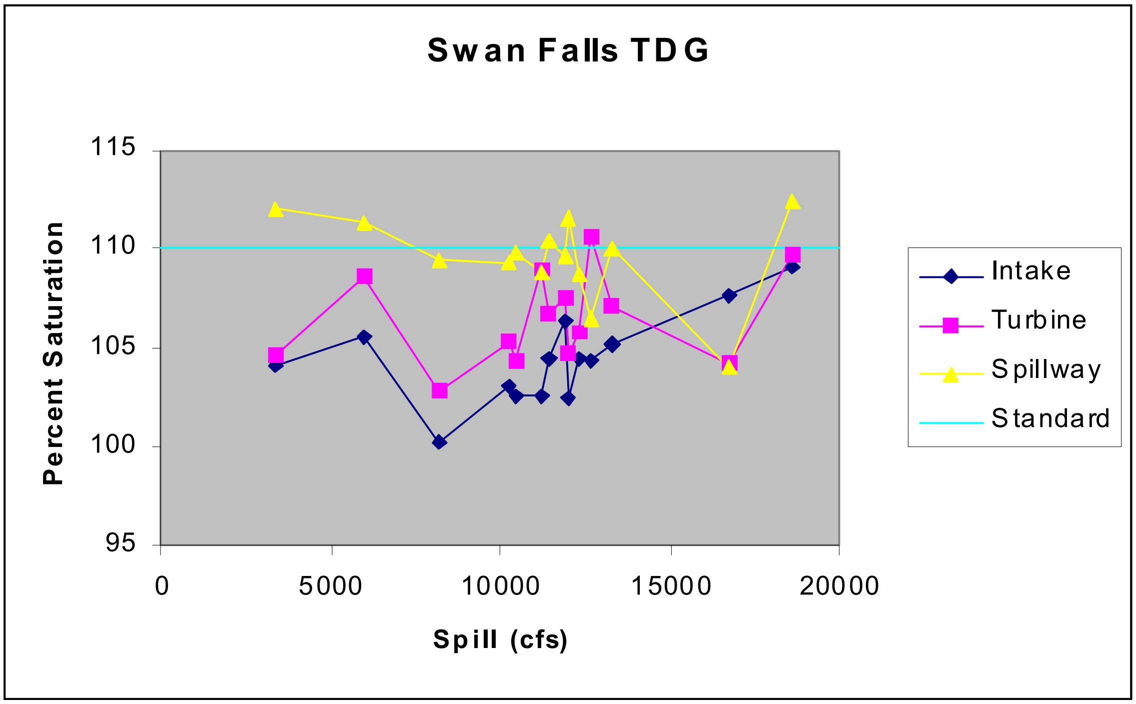

Figure 2.12 Total Dissolved Gases Below Swan Falls Dam

The TDG data outlined above show that TDG is frequently greater than 110% saturation when water is spilled above 1838 cfs at CJ Strike dam. As a result of these data, DEQ recommends listing TDG during the next §303(d) listing cycle.

Dissolved Oxygen

Insufficient DO data prevents a conclusive analysis of DO conditions at this time. However the available data do show that dissolved oxygen concentrations in the river are closely linked to nutrient and organic matter concentrations. Low DO is often the result of high nutrient, organic, or algal loading to a surface water system. Excessive nutrients can lead to algal growth. The algae, in turn, consume oxygen from the water column during periods when respiration is the dominant process and in the aerobic decomposition of the dead algae and other detritus (non-living organic material). Improvements in DO are ultimately tied to reductions in phosphorus through the corresponding reductions in algae growth. DEQ does not recommend an explicit DO TMDL at this time. Rather, DO conditions will be monitored as part of the nutrient TMDL to determine if additional actions (beyond the nutrient TMDL) are necessary.

Nutrients

The Snake River from Swan Falls Dam to the Oregon border is listed for nutrients. The 1999 and 2000 data sets used for calculation of the daily load did not show nutrient levels over the target concentration upstream of Swan Falls Dam. However, due to complaints about macrophytes in the Swan Falls Reservoir area, as well as total phosphorus levels slightly above the target concentration (0.071 mg/L) coming out of CJ Strike Dam, nutrient monitoring will continue in the upstream segment.

The designated beneficial uses determined to be most at risk from excess nutrients were those associated with aesthetics, recreation, and aquatic life. A 0.07 mg/L TP target is used for this TMDL (target selection is discussed in detail in Chapter 5) based on beneficial use support.

As shown in Figures 2.13-2.17, TP concentrations were near or above the 0.07 mg/L target in every year monitored. Raw data was provided by Idaho Power Company (IPC 2002) and USGS (USGS 2000). Differences in concentration levels are attributable to differences in water volume, cropping patterns, etc. Instream phosphorus concentrations increase in a downstream direction, as shown in Figures 2.13-2.17.

In the SR-HC TMDL, chlorophyll-a levels and total phosphorus concentrations were linked to show impairment of recreational beneficial uses in relation to nutrient/chlorophyll levels. Chlorophyll-a is an indirect measurement of the amount of algal productivity in a water body or in basic terms, how green the water is. At levels above 30 micrograms per liter (ug/L), recreationalists no longer find recreating desirable (DEQ 2001). A target of 14 ug/L chlorophyll-a (mean growing season concentration) and a nuisance threshold of between 25 and 30 ug/L of chlorophyll-a have been established as the chlorophyll-a targets for this TMDL. These targets were adopted from the SR-HC TMDL. Figure 2.20 shows the annual maximum concentrations monitored. This data is from routine monitoring, not monitoring of peak algal blooms. Typically, in mid-summer the margins of the river from Walters Ferry downstream have algal mats and macrophytes present in thick quantities forming 10-foot wide ribbons down either side of the river. Nuisance macrophyte growth has been reported upstream of Swan Falls Dam in the reservoir area. DEQ has also received complaint calls regarding the condition of the Snake River segment, particularly in the area below Marsing, concerning aesthetics and the odor from the algal mats. Downstream of Marsing is also where the highest concentrations of instream TP are found.

Direct effects associated with recreational uses include decreased utilization of the river due to unfavorable water color, low water clarity, and unpleasant odor. Indirect effects associated with aquatic life uses include low DO levels deep in the water column due to the decomposition of algae and other aquatic plant materials and high in the water column due to diurnal effects associated with substantial algae blooms. Excessively low DO levels result in reduced fitness of fish and eventually, increased mortality incidence.

As aesthetic water quality and public perception are difficult to measure directly, those characteristics of water that are generally considered unappealing were evaluated. Dominant factors in the perception of water quality are coloration, odor, and level of aquatic growth. Because it is correlated with all of these factors, algae were identified as a good indicator of aesthetic water quality. As discussed previously, a surrogate measure of algal growth is chlorophyll-a. This was used as a surrogate measure of aesthetic water quality for the purposes of this assessment.

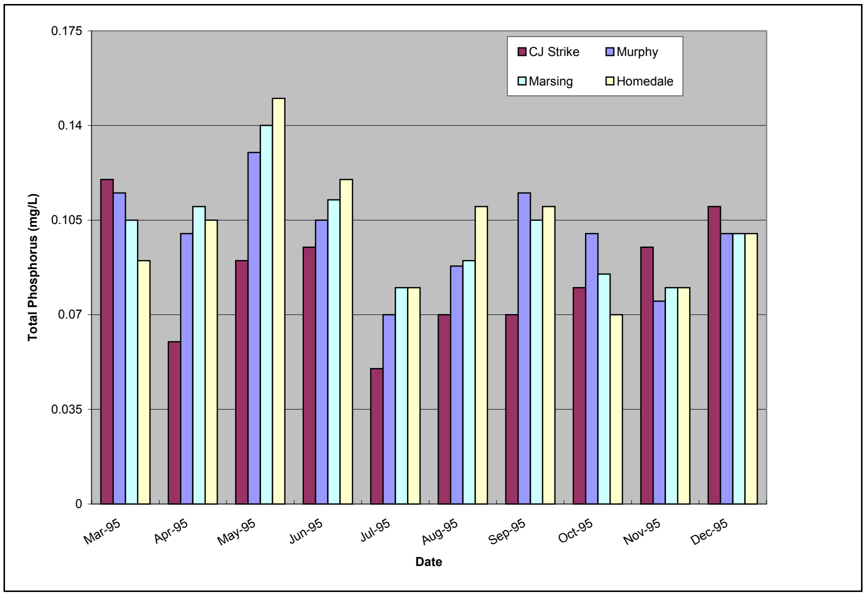

Figure 2.13 1995 Total Phosphorus Concentrations in the Snake River below CJ Strike Dam and at Celebration Park (Murphy), Marsing, and Homedale

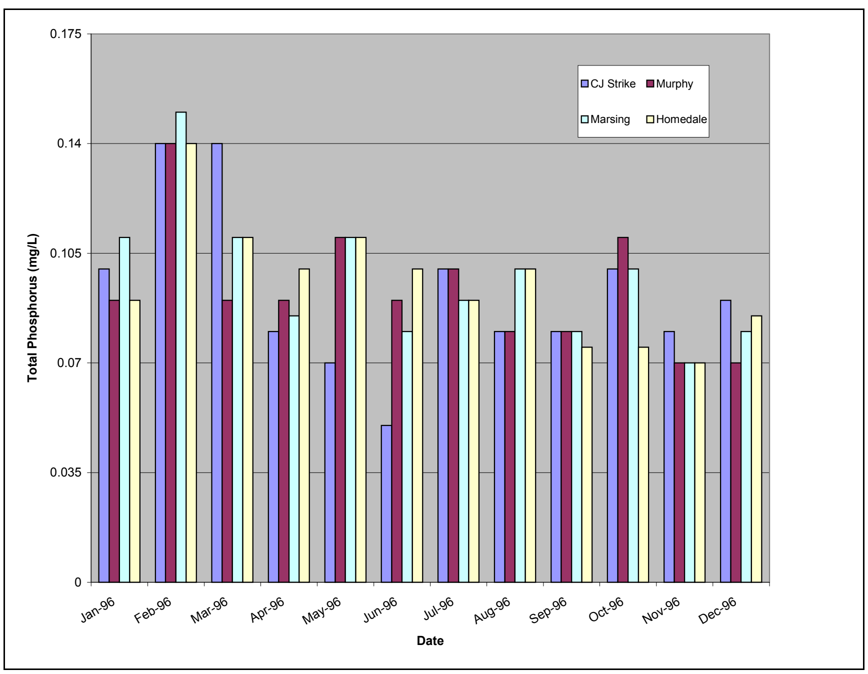

Figure 2.14 1996 Total Phosphorus Concentrations in the Snake River below CJ Strike Dam, and at Celebration Park (Murphy), Marsing, and Homedale

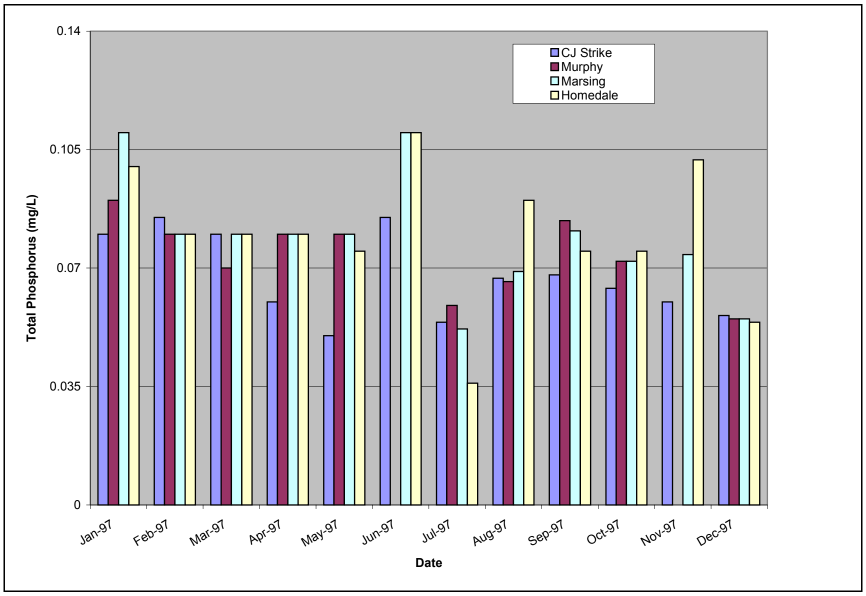

Figure 2.15 1997 Total Phosphorus Concentrations in the Snake River below CJ Strike Dam, and at Celebration Park (Murphy), Marsing, and Homedale

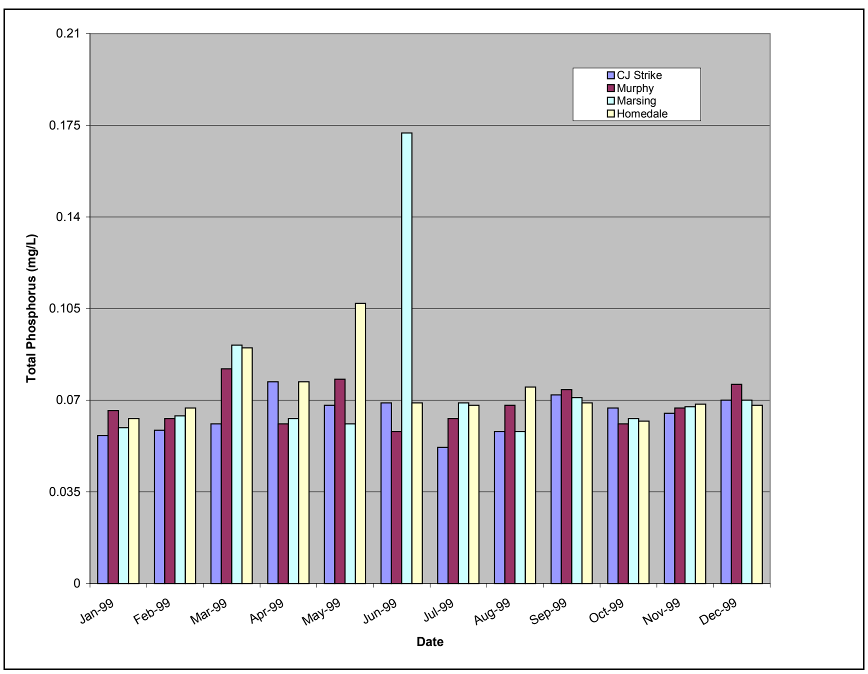

Figure 2.16 1999 Total Phosphorus Concentrations in the Snake River below CJ Strike Dam, and at Celebration Park (Murphy), Marsing, and Homedale

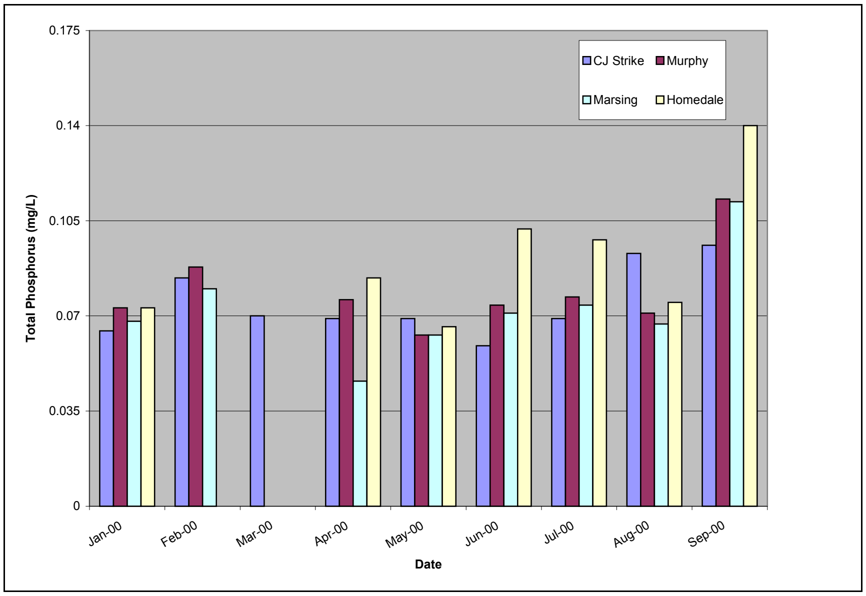

Figure 2.17 2000 Total Phosphorus Concentrations in the Snake River below CJ Strike Dam, and at Celebration Park (Murphy), Marsing, and Homedale

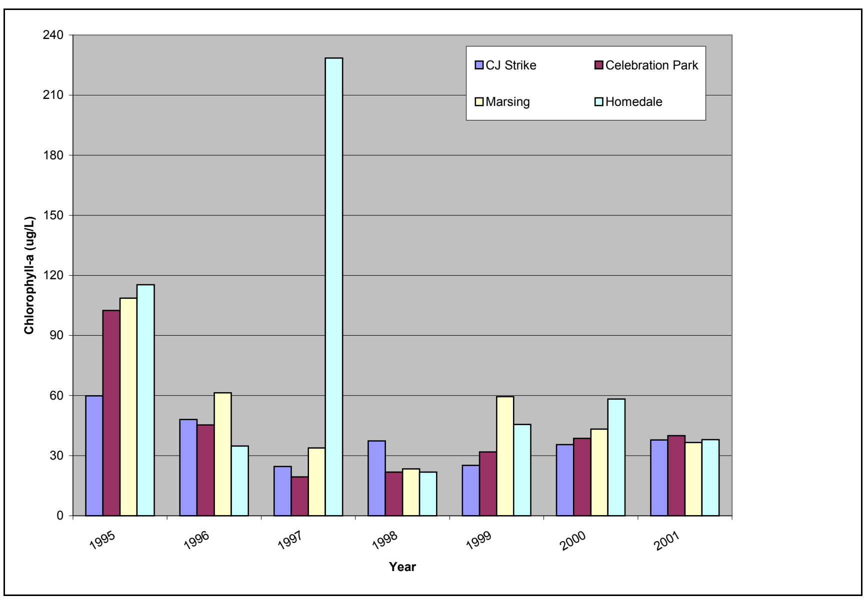

Figure 2.18 1995-2001 Maximum Annual Chlorophyll Concentrations in the Snake River below CJ Strike Dam, and at Celebration Park (Murphy), Marsing, and Homedale

Fisheries

The Snake River supports both cool and warm water fisheries. Table 11 shows the results of a recent U.S. Geological Survey (USGS) electrofishing effort below Swan Falls Dam, which showed a dominance of suckers and whitefish. The section of river from CJ Strike Dam to Swan Falls Dam is dominated by carp as shown in Figure 2.19 (IDFG 1989). The section of the Snake River from Swan Falls Dam down to the state line was dominated by small mouth bass in 1988, as shown in Figure 2.20. Historically, anadromous spawning occurred in this reach. However, the presence of dams and elevated water temperatures prevent this from happening today.

Mountain whitefish, a salmonid species, spawn in the river segment below CJ Strike Dam. Spawning is triggered by a change in water temperature. Initiation of spawning occurs between 8-9 °C and peak spawning occurs between approximately 5-6 °C. Based on available temperature data, whitefish spawning primarily occurs between mid and late November and peaks in late December (Hoelscher, IPC, personal communication, 2002).

White sturgeon, a threatened species, are found in this the river segment below C.J Strike Dam, particularly in the faster flowing areas below Swan Falls Dam. Spawning habitat is closely linked to flow. Both discharge and temperature are triggers for spawning activity. Sturgeon eggs are broadcast and no parental care is provided. Eggs that settle into channels in high velocity areas are not as subject to predation as eggs that are found in slower moving water.

The low gradient section of the Snake River from Walters Ferry to the state line has the least potential for sturgeon spawning (IPC 1998). The only documented spawning area in the reach from below CJ Strike Dam to Swan Falls Dam is in the tailrace of CJ Strike Dam.

Juvenile and adult sturgeon are typically found in large deep pools, along current breaks, or in the thalweg of runs.

Table 11. 2000 electrofishing results: Snake River below Swan Falls Dam.

Organism Name: Genus Species (Common)	Number of Individuals	Percent Composition	Length Range Total (mm)	Weight Range (gm)	Origin	Trophic Group of Adults
Catostomidae columbianus (bridgelip sucker)	10	6.8	278-380	227-520	Native	Herbivore
Catostomus macrocheilus (largescale sucker)	67	45.6	36-537	1-1,505	Native	Omnivore
Micropterus dolomieui (smallmouth bass)	19	12.9	28-336	1-410	Introduced	Piscivore
Acrocheilus alutaceus (chislemouth)	6	4.1	40-275	1-200	Native	Herbivore
Cyprinus carpio (common carp)	7	4.8	6-680	1,520-5,600	Introduced	Omnivore
Ptychocheilus oregonensis (northern pikeminnow)	1	0.7	415	680	Native	Invertivore
Ictalurus punctatus (channel catfish)	1	0.7	496	1045	Introduced	Omnivore
Prosopium williamsoni (mountain whitefish)	36	24.5	124-374	17-583	Native	Invertivore

Collection Methods: Electrofishing; boat, backpack, Length Reach: 1,280 m, Time elapsed for each collection method: 13A 0.37 hours, 11A 0.20 hours, USGS 2000

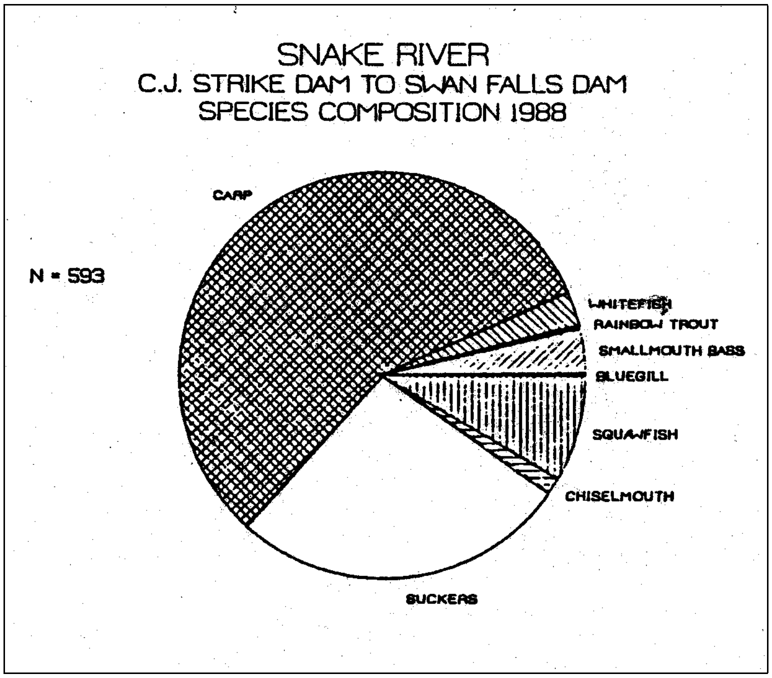

Figure 2.19 Species Composition: Snake River from CJ Strike Dam to Swan Falls Dam

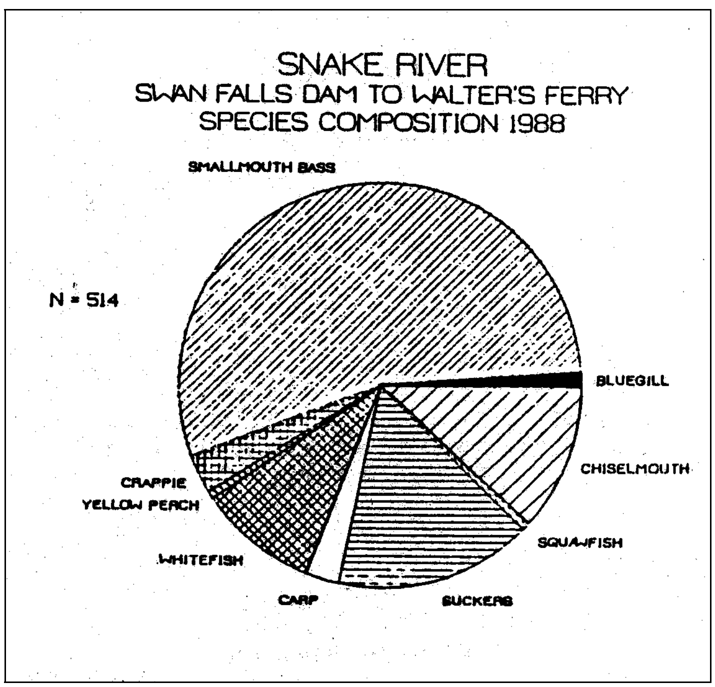

Figure 2.20 Species Composition from Swan Falls Dam to Walters Ferry

Macroinvertebrates
A Section 10 report for USFWS by Idaho Power described data for the listed reach starting below CJ Strike Dam to 36 miles downstream for macroinvertebrates (IPC 2001). The results showed a benthic community tolerant to organic enrichment and sediment. The samples were taken in predominantly run (shallow/fast) habitat with cobble-gravel substrate. After collection and identification, a series of biological assessment metrics were calculated, as shown in Table 12. The Idaho spring snail, listed as endangered, was found in 20% of the river collections and was found in greater densities in the edge water. River pool areas were dominated by the New Zealand mudsnail. These snails were found in 19% of the samples. Collector/gatherer macroinvertebrates represented the largest functional group collected.

Table 12. Macroinvertebrate survey results downstream of CJ Strike Dam (river miles 492-494, 489-491, 483-488, 478-482, 473-477, 468-472).

Metric	Result
Taxa Richness	48
Hilsenhoff Biotic Index	5.7
EPT[1] (no plecoptera)	20
EPTd/Chir[2]	3.2:1
Percent Idaho Springsnail	20%
Percent Dominant	20%
Percent Predator	3%
Percent Scraper	27%
Percent Collector/Gatherer	43%
Percent Collector/Filterer	25%
Percent Shredder	2%
Percent New Zealand Mudsnail	19%

1 Ephemeroptera, Plecoptera, Tricoptera
2 Chironomidae

U.S. Geological Survey water year 1998 macroinvertebrate data showed a Hilsenhoff Biotic Index scores of 5.37 and 5.32, indicating some amount of organic pollution. This was consistent with the Idaho Power data shown above. The *Hydropsyche* and *Cheumatopsyche* genera that dominated the sample are pollution tolerant, indicating some amount of degradation in the reach.

Status of Beneficial Uses in the Snake River
Cold water aquatic life and recreational uses in the Snake River are impaired due to high nutrient levels. In-river nutrient concentrations result in nuisance aquatic growth and low DO levels which impair aquatic life and recreational uses. Elevated temperatures are impairing cold water aquatic life as evidenced by the summer 2002 Mountain Whitefish fish kill.

Conclusions

A TMDL will be completed for nutrients. Temperature will be recommended for listing during the next practical §303(d) cycle and a thermal site potential study will be done. DEQ also recommends that TDG be listed in the Snake River from below CJ Strike Dam to Castle Creek on the next §303(d) list. Sediment, pH, and bacteria are proposed for de-listing. Since changes in DO are closely tied to nutrient reductions, an explicit TMDL for DO will not be prepared at this time. The nutrient TMDL will have the net effect of increasing DO concentrations throughout the river. As such, the nutrient TMDL is essentially a surrogate DO TMDL. While an explict DO TMDL will not be prepared, DO will remain on the §303(d) list and monitored in conjunction with nutrient monitoring to track improvements.

Castle Creek

This section describes the physical, chemical and biological data for the listed segment of Castle Creek as well as separate discussions of the listed pollutants for North Fork Castle Creek and South Fork Castle Creek.

Hydrology

As shown in Figure 2.21, the only continuous flow measurement records for Castle Creek date back to 1910 (USGS 2002). These flow measurements were taken slightly above the upstream boundary of the listed reach. Peak runoff generally occurs in spring (April-May), although rain on snow events can cause early peak flows. During 2002, flows were below 1.0 cfs near the mouth by mid-July due to irrigation diversions upstream.

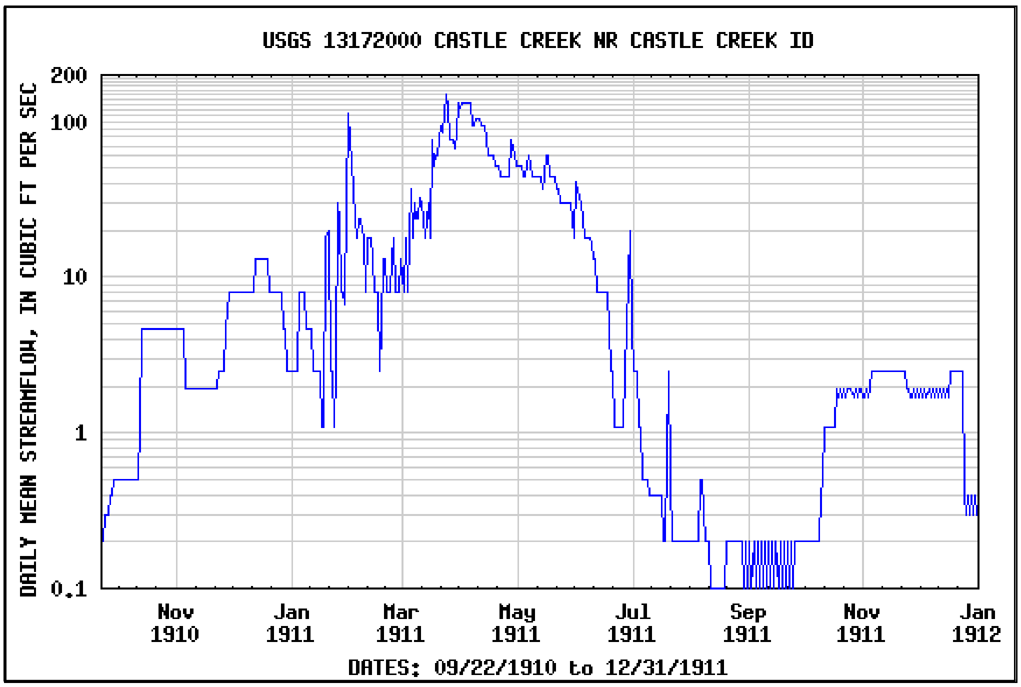

Figure 2.21 1910-1911 Hydrograph for Castle Creek

Temperature

Temperature loggers were installed on Castle Creek in spring of 2002. The locations are shown in Table 13 and Figure 2.22. Although Castle Creek is designated for salmonid spawning, IDFG determined that it is not an existing use in the listed section, nor is it likely to have been a historic use due to the low gradient and lack of spawning habitat (see Appendix F). Thus, the cold water aquatic life temperature criteria will be the only aquatic life standard used in the assessment of Castle Creek temperature data.

Table 13. Castle Creek temperature logger locations.

Site Name	Location
Castle 1	T4SR2ES06 SW/NW
Castle 2	T4SR1ES13 NE/NE
Castle 3	T5SR1ES10 NW/SW
Castle 3 Air	T5SR1ES10 NW/SW
Castle 4	T5SR1ES32 NE

The listed section of Castle Creek passes through agricultural lands where there is a reliance on geothermal artesian water for irrigation. Idaho Department of Water Resources (IDWR) records show flowing wells throughout the listed section of the watershed. Water comes out of the ground at temperatures close to 140 °F. Typically, the water flows into a cooling pond prior to irrigation use. After the water is used to irrigate, it is returned to Castle Creek via subsurface laminar flow or overland flow. A significant portion of the flow in Castle Creek during low flow months potentially consists of this cooled artesian water. Two of the flowing wells pre-date the CWA according to IDWR water rights records. The rest of the wells were drilled after 1972.

Stakeholders within the Castle Creek subwatershed are concerned that the bulk of the flow in Castle Creek is due to return water from these agricultural practices. DEQ staff investigated the use and location of artesian wells but due to time constraints was unable to quantitatively determine the amount of flow entering the creek from these sources. DEQ proposes to estimate a water budget for the subwatershed to determine the percentage of water in the stream resulting from artesian agricultural return. If a significant percentage is from the warm artesian return water, the necessity for a TMDL will be evaluated.

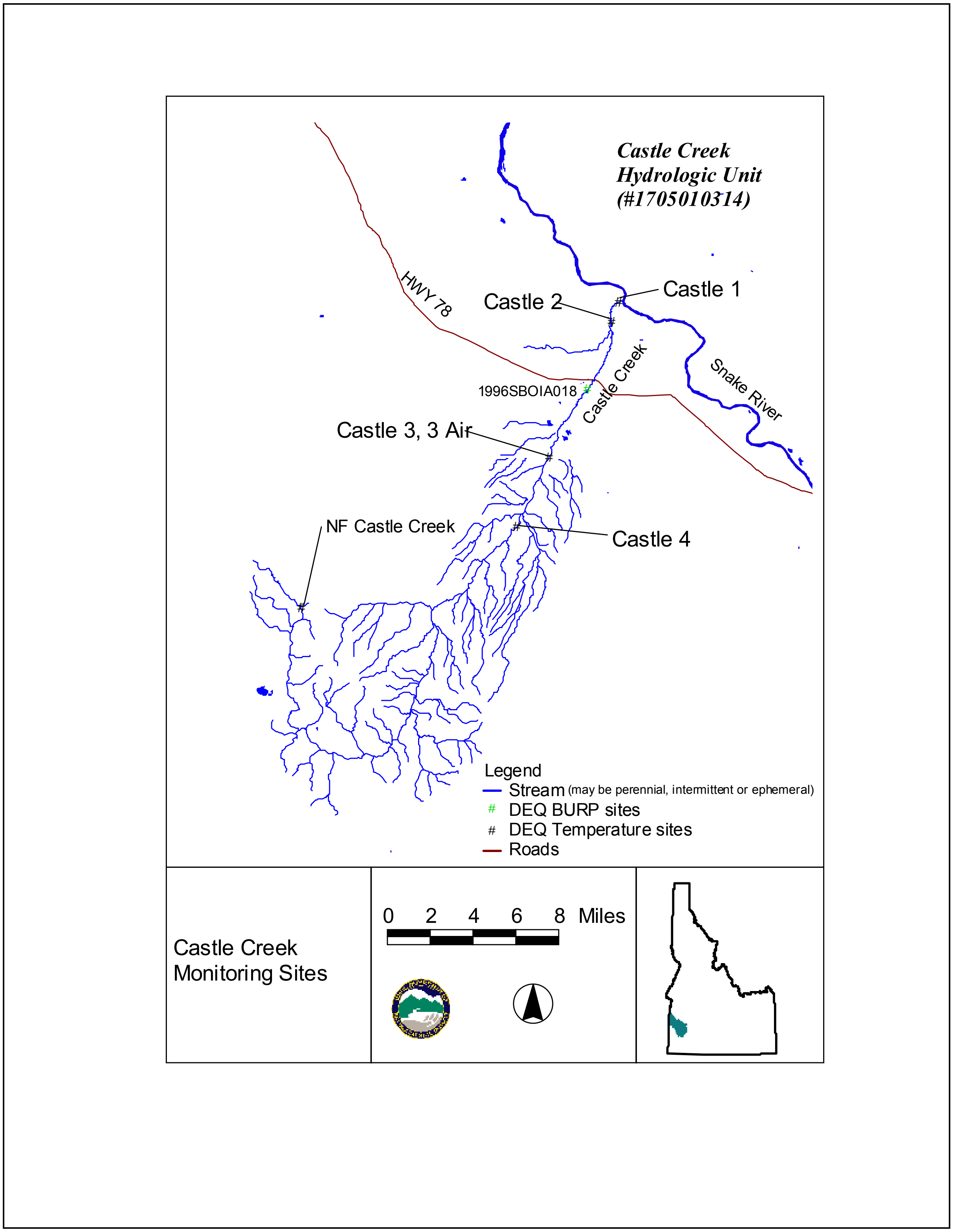

Figure 2.22 Castle Creek Monitoring Sites

Fisheries
The listed portion of Castle Creek is a low gradient section that IDFG has determined is not salmonid spawning habitat (see Appendix F). DEQ BURP data collected in 1995 show no young-of-the-year (born that year) salmonids present in the listed section of Castle Creek. Electrofishing conducted in 2002 also showed no salmonid species.

However, further up in the watershed in the higher elevation, higher gradient areas, there are redband trout populations. Table 14 shows the redband trout population data for Castle Creek. Although the data are not shown, speckled dace dominates the fish populations in both Castle Creek and North Fork Castle Creek.

Table 14. Castle Creek fish survey results.

Site	Date	Location	Redband Density
South Fork Castle Creek	10/93	South Fork Castle Creek above Clover Creek	0.539 /m^2
Castle Creek	8/77	Castle Creek below Gordy Ranch T7S R1W Section 3	0.167/m^2
Castle Creek (96SWIRO A18)	9/02	T4S R1E Section 14	No redbands
North Fork Castle Creek	8/01	North Fork Castle Creek at Alder Creek	0.035 /m^2

Macroinvertebrates
Table 15 shows the result of macroinvertebrate sampling. The Castle Creek sample was collected in the middle section of the listed reach and indicates poor diversity within the aquatic insect community. The South Fork Castle Creek sites show a diverse community of macroinvertebrates.

Table 15. Macroinvertebrate results for Castle Creek.

Site	Location	SMI[1]	Notes
South Fork Castle Creek	T8S R1W S16	56.02	Indicates a diverse macroinvertebrate community
South Fork Castle Creek	T8S 1W S8	55.56	Indicates a diverse macroinvertebrate community
Castle Creek (96SWIRO A18)	T4S 1E S26	15.92	Indicates poor macroinvertebrate diversity

[1]Stream macroinvertebrate index

Sediment
BURP data collected in 1996 show 100% fine substrate material (particles <6.0 mm in diameter), most of which was sand sized. The listed segment of Castle Creek is a response reach and more fines are expected to accumulate in the area. However, 100% fines greatly exceeds the 28% fines target (Overton et al. 1995) and does not provide suitable substrate for cold water aquatic life. Table 16 shows the BURP data for the listed section of Castle Creek.

Table 16. Sediment results for Castle Creek.

Castle Creek	Percent Fines
Castle Creek (96SWIROA18)	100%

Bank erosion survey results show areas of 80% or more stable banks in the upper 3 miles of the listed reach. However, downstream bank stabilities of less than 80% are prevalent. Bank survey results are located in Appendix H.

Riparian Survey
Figure 2.23 shows the results of a riparian survey done by the Idaho Soil Conservation Commission in 2001 (ISCC 2001). The author observed that bank stability was primarily provided by the roots of woody vegetation and to a lesser degree by herbaceous vegetation. From marker 18 downstream (north), there was an increase in the percentage of upland plants and weeds present. The study objective was to determine present grazing effects on the riparian area. The areas observed were given ratings, which are explained in more detail below.

- High: Obvious overgrazing; herbaceous and woody species are over-utilized, in poor condition if still present, compromising stream bank stability; stream bank shape indicates impact from overuse by livestock.

- Moderate: Obvious that grazing is occurring; herbaceous and woody species are somewhat over-utilized but stream bank stability may still be intact, though compromised; large river system that does not depend on stream bank herbaceous or woody species as much for stability; substrate-controlled stream or river.

- Low: Grazing is likely occurring but either fenced away from the riparian area and/or management is excellent; herbaceous and woody species are vigorous and stream bank stability seems good.

- NA: Livestock grazing is not occurring within the riparian area.

- ?: The degree of grazing impact is not known due to limited visual access to riparian area.

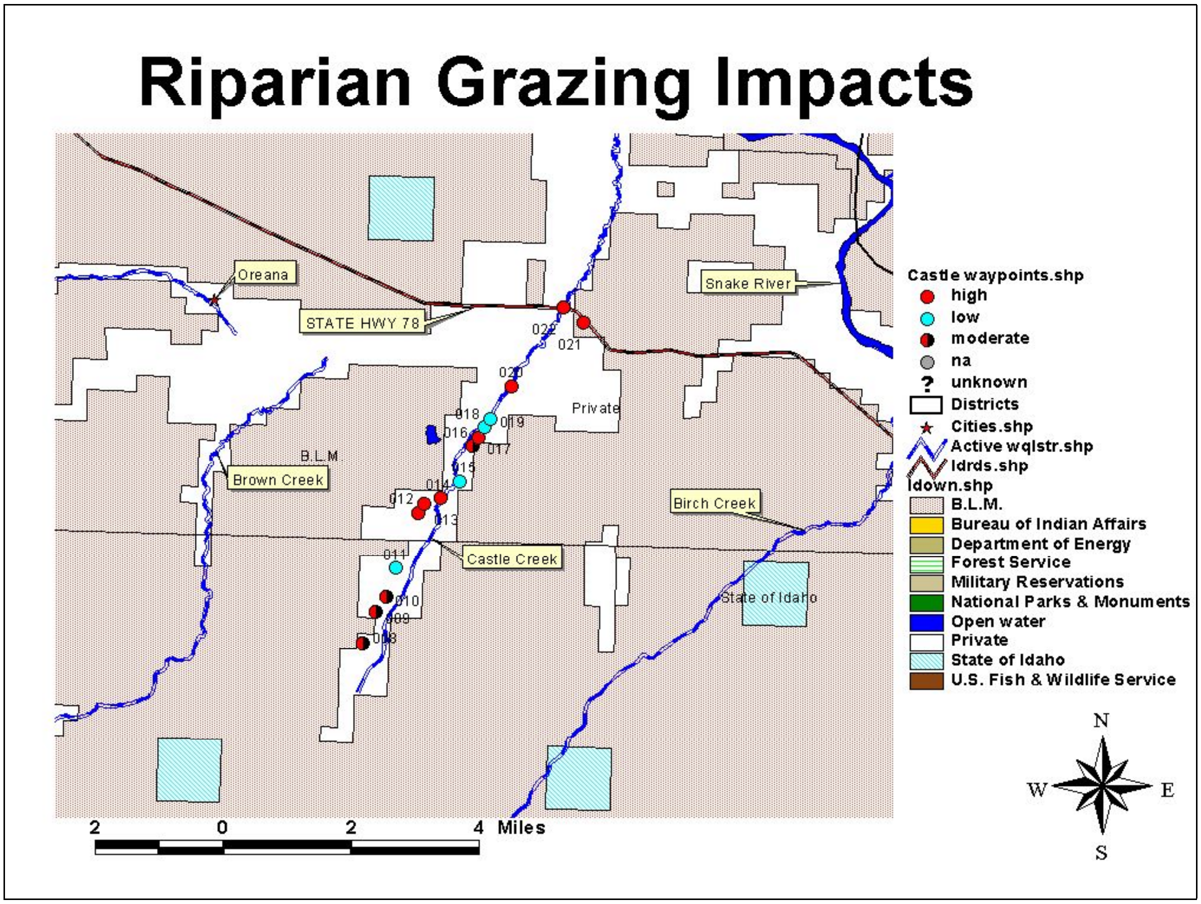

Figure 2.23 Riparian Grazing Impacts to Castle Creek

North Fork Castle Creek Temperature

North Fork Castle Creek temperature data were collected in 2002. This is a very low volume stream and inadequate flow data is available to fully characterize the system. North Fork Castle Creek goes dry in the upper sections from late June onwards although there is perennial flow farther downstream. The lack of data made it difficult to determine when flows dropped below 1 cfs. DEQ staff did not have access to the lower reaches of North Fork Castle Creek. DEQ will attempt to gain access in 2003. Figure 2.24 shows the daily average temperatures in the upper portion of the stream where DEQ was able to gain access.

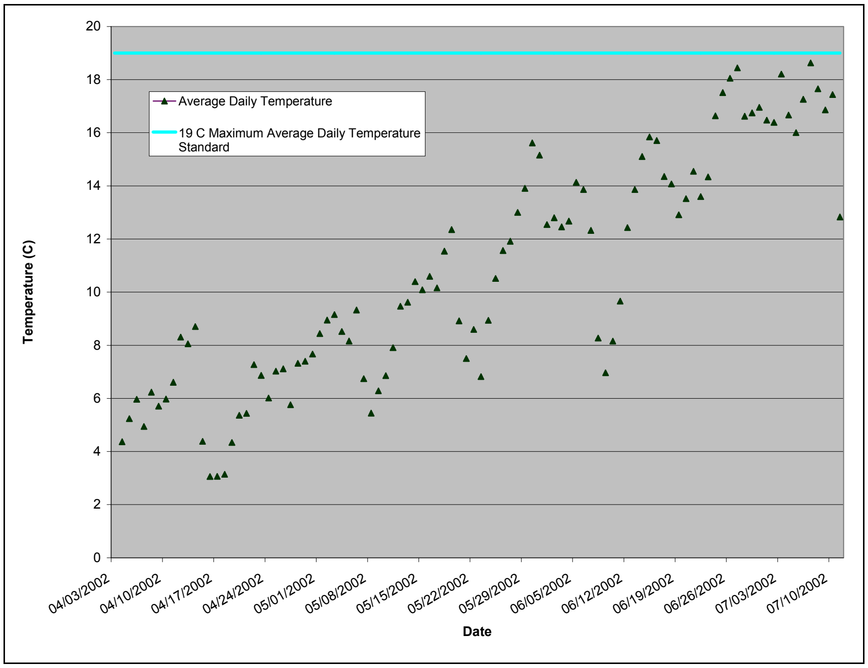

Figure 2.24 North Fork Castle Creek Average Daily Temperature (Flow > 1 cfs)

South Fork Castle Creek Bacteria

South Fork Castle Creek is listed for bacteria due to 1979 BLM data taken during the base flow period. DEQ staff were unable to resample the listed reach due to lack of access to the stream. The DEQ water body assessment process shows this reach to be fully supporting its beneficial uses.

While the current standard is based on *E. coli*, the old standard called for less than 500 cfu/100 mL instantaneously for primary contact recreation and less than 800 cfu/100 mL instantaneously for secondary contact recreation. The 1979 BLM sample met both the primary and secondary contact recreation standards.

Due to the fact that this listing is based on a single sample taken over 20 years ago, the sample met the standard at the time, and that flows in South Fork Castle Creek generally precludes ingestion, DEQ does not recommend a TMDL at this time. However, DEQ will attempt to re-sample SF Castle Creek in summer 2003 to determine definitively if the stream meets the state bacteria standards. Table 17 shows the results of BLM bacteria monitoring (BLM 1979).

Table 17. South Fork Castle Creek bacteria monitoring results

Location	Date	Fecal Coliform
South Fork Castle Creek	10/1/79	312 cfu/100mL

Status of Beneficial Uses

Cold water aquatic life uses in Castle Creek are impaired due to excess sediment in the stream, which is reflected in the low habitat and macroinvertebrate scores in the water body assessment.

Conclusions

The listed section of Castle Creek is impaired by sediment, with the greatest amount of sediment delivery occurring during periods of high flow in late spring. Bank erosion inventories indicated bank stability was less than 80%, particularly in the lower sections of the reach. Thus, a sediment TMDL for Castle Creek will be completed. The determination of whether a temperature TMDL is necessary for Castle Creek will be delayed until an evaluation of the artesion influence can be performed. This evaluation is expected to occur in 2003. The bacteria TMDL for the South Fork Castle Creek will be delayed due to a significant lack of data. Additional data is expected to be collected in 2003. The temperature TMDL for the North Fork Castle Creek will also be delayed due to a significant lack of data. Additional data will is expected to be collected in 2003.

Jump Creek

This section describes the physical, chemical and biological data for the listed segment of Jump Creek.

Surface Hydrology
Jump Creek is an intermittent stream as it flows through the Sands Basin, but becomes perennial as it reaches the Snake River Plain. The hydrology of Jump Creek has been significantly modified over time by channelization, bank stabilization activities and the development of irrigation and drainage systems (Bauer 1994). Similar to the Lower Boise River basin, which is due north, the soils in the watershed became saturated as the lands adjacent to the stream were irrigated as cropland. As irrigation continued, the ground water level increased and began to interfere with soil and crop health. In response, drains were constructed and the existing channel was deepened to drain the excess ground water.

There is not a significant amount of flow data for Jump Creek, but enough exist to accurately characterize the stream's seasonal flow fluctuation in the perennial segment. Figure 2.25 shows the typical discharge rates at four longitudinally spaced locations in Jump Creek for the years 1992 and 1993 (Bauer 1994). The year 1992 was a lower than normal water year.

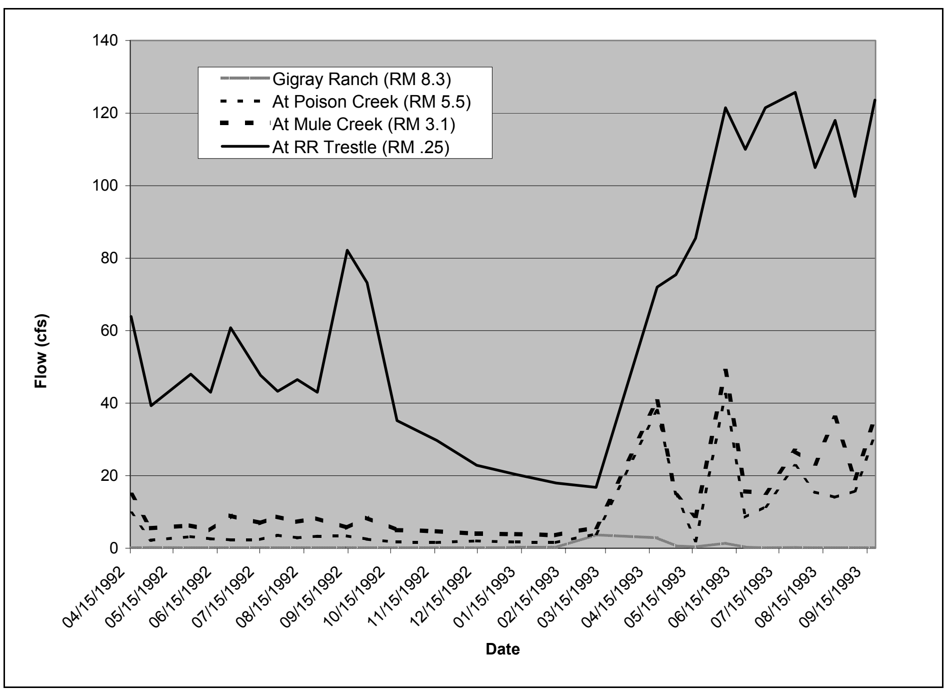

Figure 2.25 Monthly Flow at Four Locations in Jump Creek, 1992-1993.

Due to the irrigated nature of the Jump Creek subwatershed, a complicated system of canals, laterals, and diversions exists. Along with numerous small canals that drain into Jump Creek, three major water conveyances transect the system. The Southside Canal originates at the Owyhee Reservoir and travels east at the foot of the Owyhee Mountains where it joins the

A-Line and B-Line canals just upriver from Marsing. The Southside Canal has the potential to spill into Jump Creek at their intersection near Highway 78, but does so only when water is needed. The A-Line and B-Line canals convey water in a northwesterly direction from where they originate. The A-Line canal is siphoned over Jump Creek with no discharge to the creek. The B-Line is also siphoned over Jump Creek, but often spills into Jump Creek. The spill, which averages 5 cfs throughout the irrigation season, ensures the appropriate water level is maintained in the B-Line canal.

Mule Drain and Hortsman Drain account for nearly 80% of the total volume of water in Jump Creek as it enters the Snake River. However, in low flow years, such as 1992, Mule and Hortsman Drains can account for nearly all of the water in the stream. This is illustrated in Figure 2.26 (Bauer 1994).

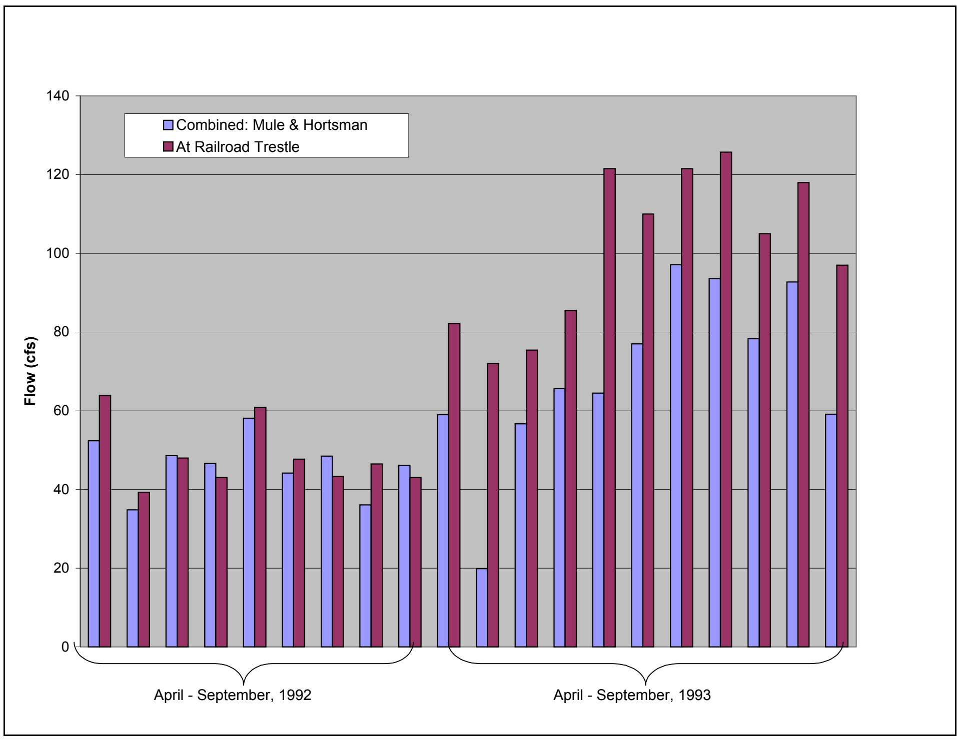

Figure 2.26 Flow Contribution to Jump Creek from Mule and Hortsman Drains, 1992 and 1993

Within the 4.9-mile stretch of stream that extends from the mouth of the canyon to the Snake River, the Town Canal withdrawal is the only major diversion. The Town Canal withdraws at an average rate of 15 cfs during the irrigation season. Jump Creek is not de-watered to the extent of other tributaries in the basin. All of the water removed from Jump Creek is used for agricultural related purposes.

Sediment
A significant amount of water column sediment data were collected by DEQ in 1992 and 1993 as part of the Jump Creek SAWQP project (Bauer 1994). Additional data have been collected by the Idaho Department of Agriculture (IDA) and Bureau of Reclamation in 2000 and 2001 for other agency-specific reasons. Figure 2.27 shows the DEQ monitoring locations. All three agencies sampled TSS, and the Bureau of Reclamation also sampled for SSC.

The irrigation season has a marked effect on TSS conditions in Jump Creek. Other than at Gigray Ranch, TSS concentrations in Jump Creek are notably higher during the irrigation season. Figure 2.28 shows beginning at Mule Creek, the typical seasonal average TSS concentration increases dramatically in the downstream direction. The concentration is nearly eighty times greater than that at Gigray Ranch by the time the stream reaches the Snake River. During the non-irrigation season the concentrations remain low, and even drop somewhat between Market Road and the Snake River. This drop is likely due to an influx of clean ground water as the stream approaches the river. The TSS loads follow the same trend as the concentrations, as illustrated in Figure 2.29. This indicates that irrigation season flows and land management activities play a critical role in TSS conditions in Jump Creek.

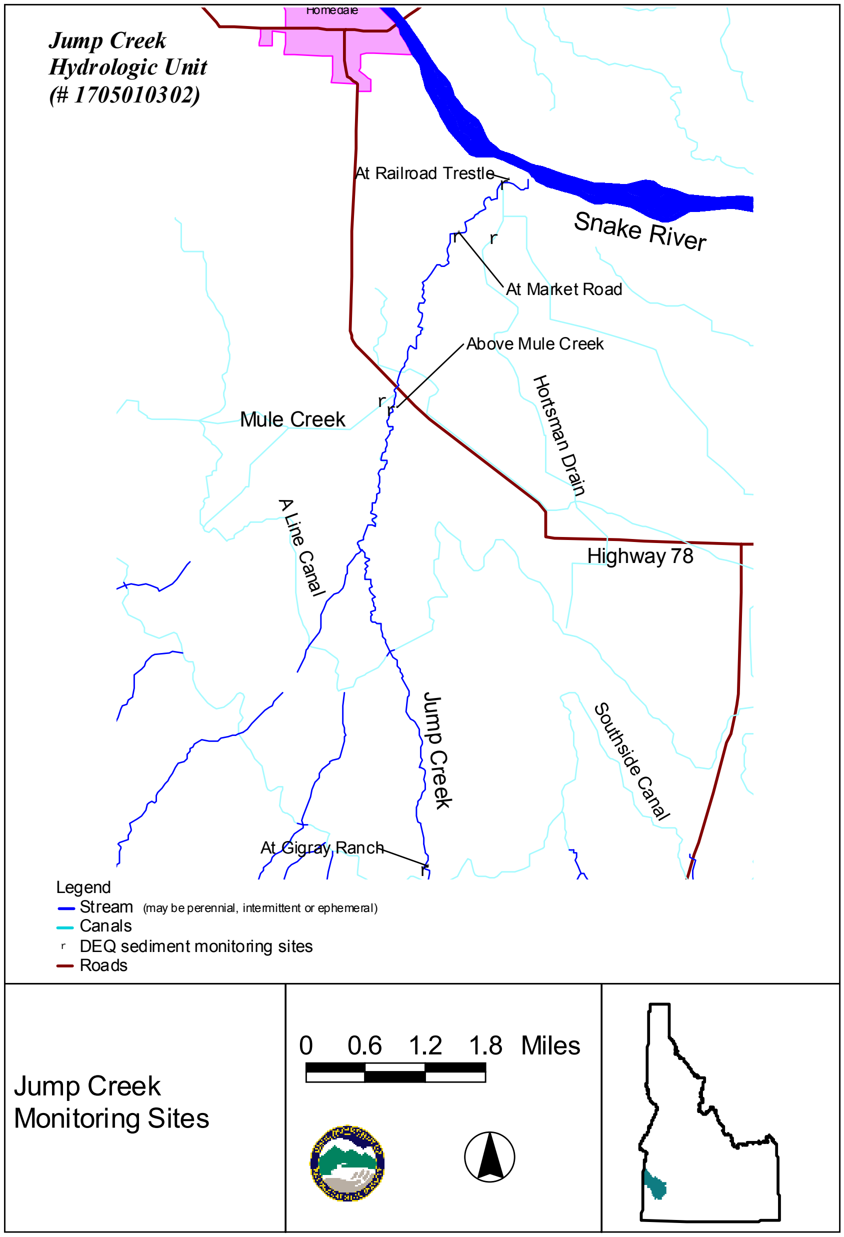

Figure 2.27 Jump Creek Monitoring Sites

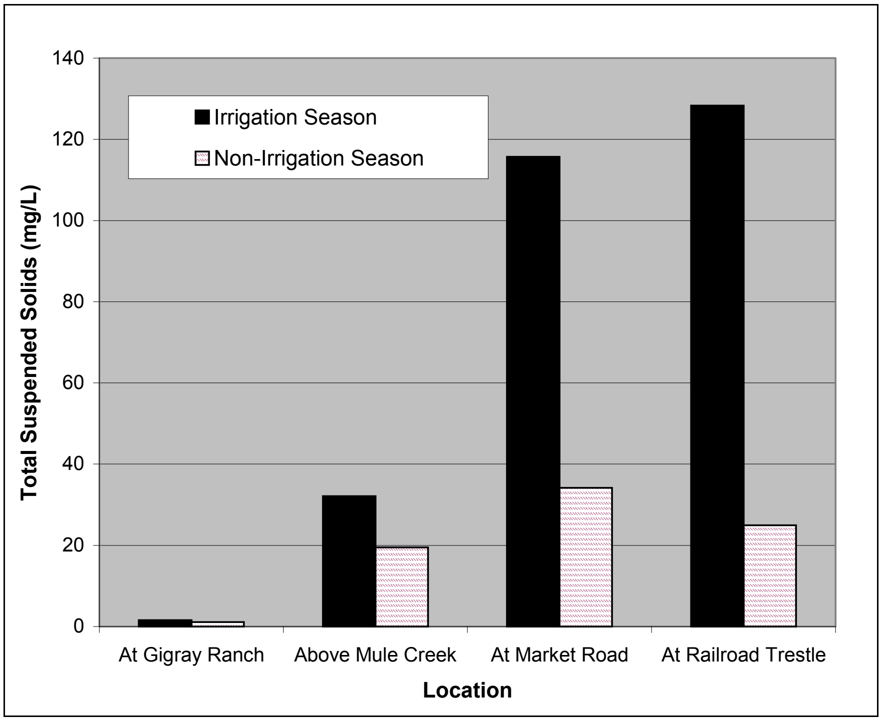

Figure 2.28 Typical Seasonal Variation in Total Suspended Solids Concentration in Jump Creek, 1992 and 1993 Irrigation Seasons

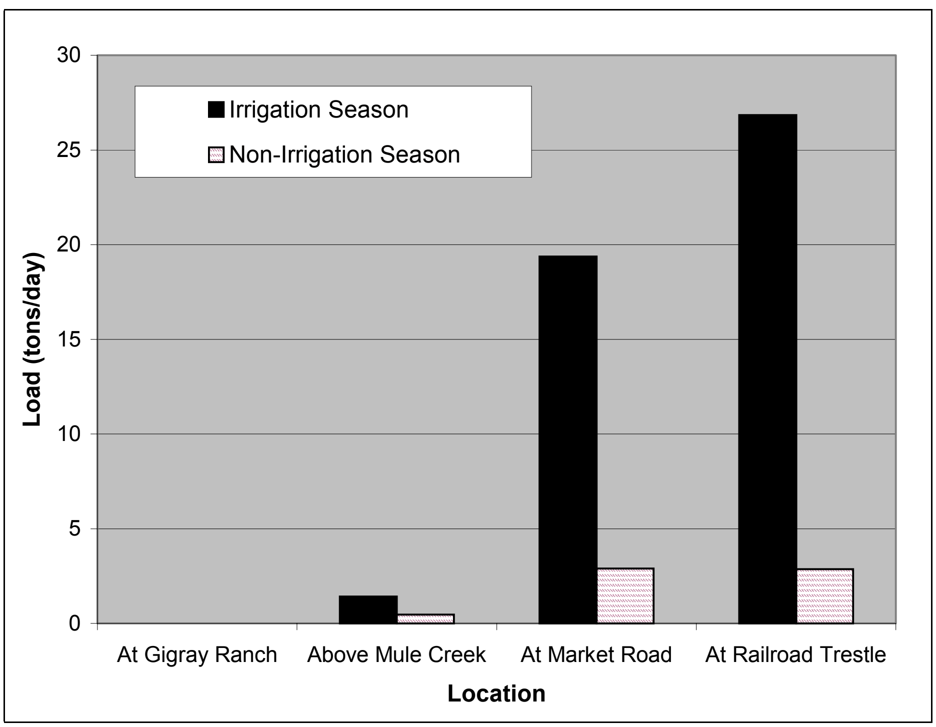

Figure 2.29 Typical Seasonal Variation in Total Suspended Solids Load in Jump Creek, 1992 and 1993 Irrigation Seasons

Jump Creek is located in an area of the watershed that has experienced very little noticeable change in the land use in the past 10 years (Griswold 2002). As a result, the sediment loads associated with particular land uses (agriculture, storm water, etc.) have remained relatively static. While the annual sediment load in any given year may fluctuate somewhat depending on the type(s) of crop being grown and the amount of water available for irrigation, the trend has remained very similar when observed over time. Figure 2.30 shows the sediment load near the mouth from a typical day each month in 1993 in comparison to 2001 loads. The sum of the annual load was 261 tons/day in 1993 and 296 tons/day in 2001. These loads are within 12% of one another, indicating the sources of loads have changed very little in the past 10 years.

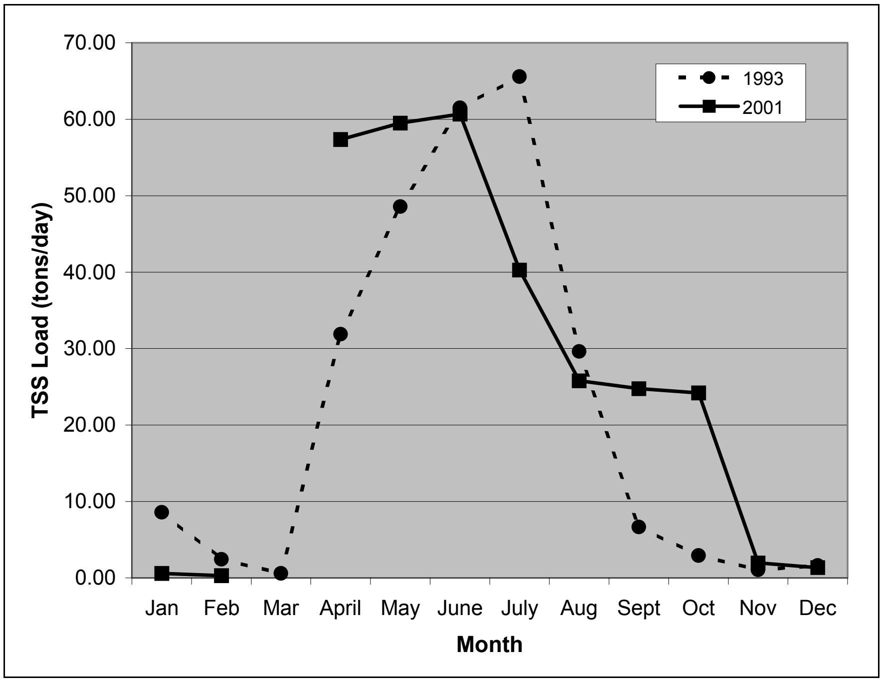

Figure 2.30 Sediment Load Near the Mouth of Jump Creek from a Typical Day each month in 1993 and 2001

Sediment Condition Assessment

As noted in Table 6, the Idaho Water Quality Standard for sediment is narrative, meaning there is not a numeric value against which TSS conditions in Jump Creek can be compared to determine compliance with the standards. However, there is a numeric water quality standard for turbidity, which says that surface water should be not exceed 25 NTU for greater than 10 consecutive days in any applicable mixing zone set by DEQ. The turbidity standard was used as a surrogate to calculate a numeric TSS target in Jump Creek. The TSS target can then be used to determine compliance with the water quality standards. The working assumption is that by decreasing turbidity levels to 25 NTU in Jump Creek there will be a measurable increase aquatic life distribution and abundance. While cold water aquatic life are not as sensitive to turbidity as they are to TSS, MacDonald (1991) suggests that enough sensitively exists to use turbidity as a cold water surrogate.

To assess the TSS condition in Jump Creek as it relates to the water quality standards, the monitoring data were used to develop a regression of TSS as a function of turbidity. The linear regression equation is based on 88 data pairs from the four longitudinally spaced monitoring locations in the stream (Gigray Ranch, at Poison Creek, above Mule Creek and at the railroad trestle). The irrigation season was determined to be the critical period because, as displayed in Figure 2.29, it is when nearly all of the loading to the stream occurs. For that reason, only data from the irrigation season were used to develop the regression. The regression equation describing the relationship between TSS and turbidity in Jump Creek is as follows:

TSS = 2.85(Turbidity) – 6.60

Figure 2.31 shows the regression of TSS as a function of turbidity. The equation has a coefficient of determination (R^2) of .93, which means that 93% of the data variability is explained by the turbidity data. This is a very good coefficient of determination, but is not surprising given that elevated turbidity levels in the water typically occur only during the irrigation season, when TSS concentrations are also elevated. The p-value is 9.33E-53, further indicating the strength of the correlation.

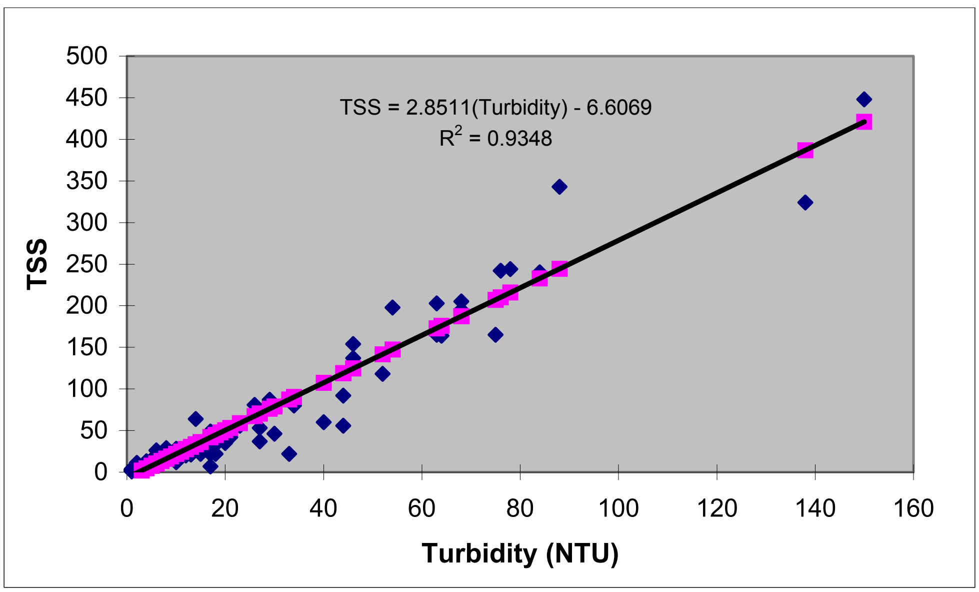

Figure 2.31 Regression of Total Suspended Solids as a Function of Turbidity in Jump Creek

By solving for TSS with a turbidity of 25 NTU, using the above regression equation, an instream TSS target of 65 mg/L was established. By maintaining 65 mg/L TSS in the stream, the turbidity standard of 25 NTU will be met. A water column suspended sediment target is desirable so that a TSS loading balance can be calculated to determine the cumulative impact of the tributaries and drains discharging to Jump Creek. Compliance with the sediment standard could be based on turbidity alone, but calculating turbidity-based loads and load reductions is difficult. With such a strong coefficient of determination, this approach will yield a better mechanism for determining how and where to make reductions.

Figure 2.28 shows that irrigation season (critical period) TSS concentrations are well in excess of 65 mg/L at the Market Road monitoring station. However, if a monitoring station had been located directly below Mule Creek, the data would have shows that instream concentrations exceed 65 mg/L as a result of Mule Creek mixing with Jump Creek. Table 18 illustrates the mixed TSS concentration of Jump Creek above Mule Creek and Mule Creek. The instream concentration increases from 32 mg/L to 157 mg/L as a result of Mule Creek mixing with Jump Creek.

Table 18. Mixed concentration of Jump Creek above Mule Creek and Mule Creek.

	Flow (cfs)	Total Suspended Solids (mg/L)
Jump Creek above Mule Creek	16.3	32.12
Mule Creek	12.11	326.21
Mixed Concentration	--	157.45

Irrigation season TSS concentrations in Jump Creek begin to exceed 65 mg/L directly below Mule Creek and continue to exceed 65 mg/L to the Snake River. As a result, the turbidity standard is not met and a TMDL is necessary for Jump Creek below Mule Creek. It is necessary for all sources, beginning with Mule Creek, to make sediment load reductions during the irrigation season. The TMDL portion of this document will describe the source reductions that must occur.

Fisheries

Fisheries data were available throughout most of Jump Creek. DEQ collected fish data in June 1992 at six locations extending from directly below the falls to directly above the Snake River. Rainbow trout, including juveniles, were located directly below the falls as well as near the mouth of the canyon. Below the canyon, only dace species, redside shiners and sucker species were located. The decline in salmonids was attributed to a loss of instream habitat complexity and a decrease in water clarity (Bauer 1994).

IDFG collected data at two locations directly above and below the Jump Creek Falls in 1994 (Allen 1995). Above the falls, IDFG estimated the density of redband trout to be 17 fish per 100 square meter. Of the 27 fish located, two were young of the year, suggesting that the fish are spawning in the stream. Below the falls, IDFG estimated the density of redband trout to be 58 fish per 100 square meter. A total of 86 fish were located, with 23 being young-of the-year, again indicating that the fish are successfully spawning in the stream. A comparison of the 1994 IDFG fish data to unpublished BLM data collected in 1977 indicates similar fish densities below the falls. Given the unmanaged and isolated nature of these sampling locations, it is unlikely that the fish populations have changed in recent time.

Macroinvertebrates
Macroinvertebrate samples were collected in 1998 in the Sands Basin and directly below Jump Creek Falls as part of BURP. The data from the Sands Basin location are not considered in this discussion because the stream is largely intermittent at that location. Directly below the falls, the SMI rating was 47.7, yielding a condition rating of 2.0 and an SMI-based support status of full support.

Macroinvertebrates were also sampled at four locations in 1993 as part of the Jump Creek SAWQP project. The samples were collected directly below the falls, at Gigray Ranch (near the mouth of the canyon), at Cemetery Road (below Poison Creek) and near the railroad trestle (near the mouth). The macroinvertebrate community showed a downstream decline in community diversity and in desirable taxa such as Ephemeroptera, Plecoptera and Tricoptera (EPT). The decline was attributed to the downstream loss of instream habitat, primarily suitable substrate complexity (Bauer 1994).

Status of Beneficial Uses
The data indicate that excess sediment is contributing to the decline in cold water aquatic life in Jump Creek. Consequently, DEQ recommends preparing a TMDL for sediment with the intent of reducing TSS and turbidity levels and restoring cold water aquatic life to full support. Table 19 summarizes the beneficial use support status for Jump Creek.

Table 19. Status of Beneficial Uses in Jump Creek.

Segment	Designated Uses	Impaired Use	Pollutant Causing Impairment
Mule Creek to Snake River	Cold water aquatic life, primary contact recreation	Cold water aquatic life	Excess Sediment

Reynolds Creek

This section describes the physical, chemical and biological data for the listed segment of Reynolds Creek.

Surface Hydrology
Reynolds Creek is a perennial stream, even though at least 75% of the annual precipitation in the subwatershed occurs as snowfall (Hanson 2000). There is a significant amount of flow data (daily from 1963 to 2002) available from the Reynolds Creek Agricultural Research Station. Data are also available from other sources below the experimental station, but are far less frequent. Figure 2.32 shows the mean monthly discharge for Reynolds Creek at the Reynolds Creek Experimental Watershed (RCEW) outlet gauge, which is located just below Salmon Creek. The period of record is 1963 to 1996. The greatest mean monthly discharge occurs during the month of May due to snowmelt. The outlet gauge provides the best approximation of the flow volume reaching the lower segment of the stream (where the §303(d) listed segment is located) because there are only a few intermittent surface related inputs between the outlet gauge and the lower segment. The influence of groundwater input and losses on streamflow is unknown.

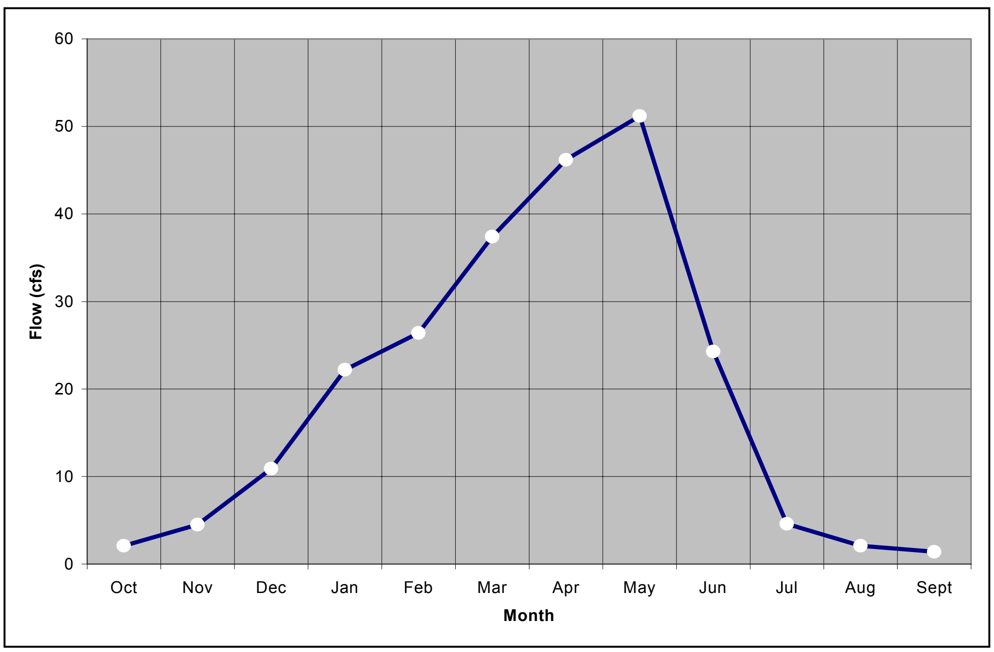

Figure 2.32 Mean Monthly Flow at the Reynolds Creek Experimental Watershed Outlet Gauge, 1963-1996

As mentioned, flow data for Reynolds Creek below the experimental station are far less abundant. BURP data collected on July 1, 1998, show a flow of 5.82 cfs just above Highway 78 and 22.37 cfs directly below the mouth of the canyon. Data collected in early 2002 shows a flow of slightly more than 3.0 cfs at the Highway 78 and 7.0 cfs at the mouth of the canyon.

Note the significant decrease in flow volume between the mouth of the canyon and Highway 78 in both years. Within this 4.9-mile stretch of stream that extends from the mouth of the canyon to the Snake River there are eight registered points of diversion, including the Bernard Ditch. Table 20 lists the diversion names and the cumulative water rights for each. These diversion structures de-water much of the lower segment for agricultural purposes. The total water right for Reynolds Creek during the period of March 15 – November 15 is 104.56 cfs. It should also be noted that the flows shown above were not normal, and may have been due to storm events that had recently occurred.

Table 20. Registered Points of diversion in Reynolds Creek from the mouth of the canyon to the Snake River.

Diversion Name (upstream to downstream)	Cumulative Water Right (cfs)
R. Brandau (East Ditch)	2.40[1]
R. Brandau (West Ditch)	2.40[1]
R.I.D. Lateral (Bernard Ditch)	17.24
Brandau Farms[2]	1.57
West Reynolds Lateral	9.78
H. Brandau	2.20
Young and Foote	15.14
Last Ditch Lateral	6.90

[1]R. Brandau East and West Ditch combined right is 2.40 cfs.
[2]Brandau Farms is also included in the combined R.I.D. Lateral since it can be diverted at either location.

An important feature of the hydrologic regime in Reynolds Creek is the peak discharge (flooding) events. These events have redefined the channel shape as the stream flows through the Snake River plain (Brandau 2002) and, generally speaking, these events account for most of the sediment yield from the Reynolds Creek Research Watershed (Johnson et al. 1974). While experimental station sediment data are not available below the outlet weir, it is reasonable to assume that the same is true regarding Reynolds Creek in the Snake River plain. Table 21 shows the ten highest recorded flows, organized chronologically, at the RCEW outlet gauge. Note that in1982 the flows occur within the same year. These flows were primarily a result of rain-on-snow events (Pierson et. al. 2000). Figure 2.33 shows the impact of a1956 flood on Reynolds Creek in the Snake River plain.

Table 21. Ten highest recorded flows at the Reynolds Creek Experimental Watershed outlet gauge, 1963-1996.

Date	Peak Flow (cfs)	Date	Peak Flow (cfs)
01-31-63	2,331	03-02-72	667
12-23-64	3,850	06-11-77	1,119
01-28-65	1,113	01-11-79	1,662
01-21-69	899	02-15-82	2,082
01-27-70	728	04-11-82	861

Figure 2.33 1956 Flood, Photo Taken Just Above Highway 78

Sediment
The water column sediment data available for Reynolds Creek below the Bernard Ditch is limited to TSS measurements collected by Analytical Laboratories in Boise during 1999, 2000, and 2001. Figure 2.34 shows the monitoring locations. The suspended solids data are shown in Figure 2.35 (ERO 2002). The data suggest that there is essentially no change in suspended material between the mouth of the canyon and Highway 78 and show that concentrations are very low. This is the case because there is very little agricultural return water below the Bernard Ditch. While several of the diversions listed in Table 20 can return water to Reynolds Creek, the water is used to irrigate grass pastures, which are high residue (retain soil well) and typically trap more sediment than they liberate. The stream bottom was visible at the Highway 78 crossing, even at high water, during March, April, May, and June 2002.

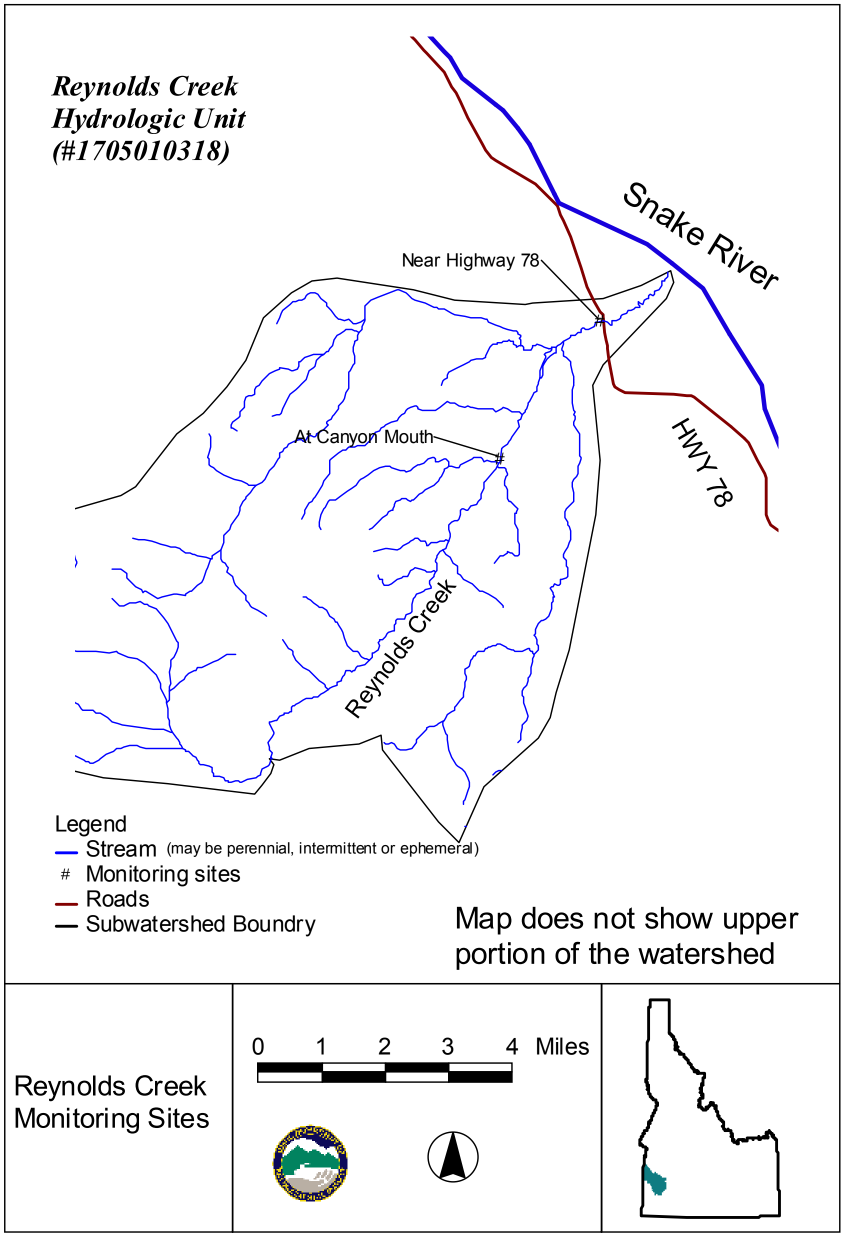

Figure 2.34 Reynolds Creek Monitoring Sites

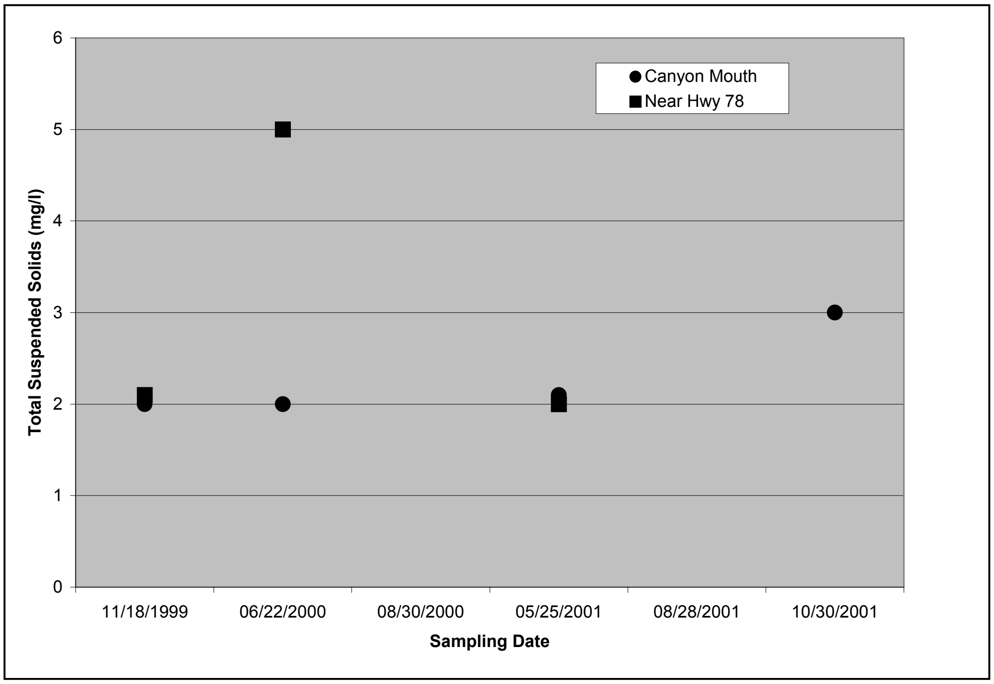

Figure 2.35 Total Suspended Solids Concentrations in Reynolds Creek, 1999 - 2001

Beyond the suspended solids data shown in Figure 2.35, there is no additional water column sediment information available below the RCEW outlet monitoring station. However, because only a few small, canyon-bound tributaries enter Reynolds Creek between the outlet monitoring site and where the stream enters the Snake River Plain, and the stream itself is bound by steep canyon walls, the RCEW data provide a reasonable estimation of suspended sediment conditions throughout the listed segment.

Suspended sediment data are available from the RCEW from 1965 to 1996. Figure 2.36 shows the suspended sediment monthly geometric means for the year 1995, a typical water year. The peak concentration that occurred in May is consistent with the findings of Johnson et al. (1974), in which they concluded runoff events yield most of the sediment in the Reynolds Creek Experimental Watershed. Figure 2.32 shows that for the period of record the highest mean monthly flows occur in May.

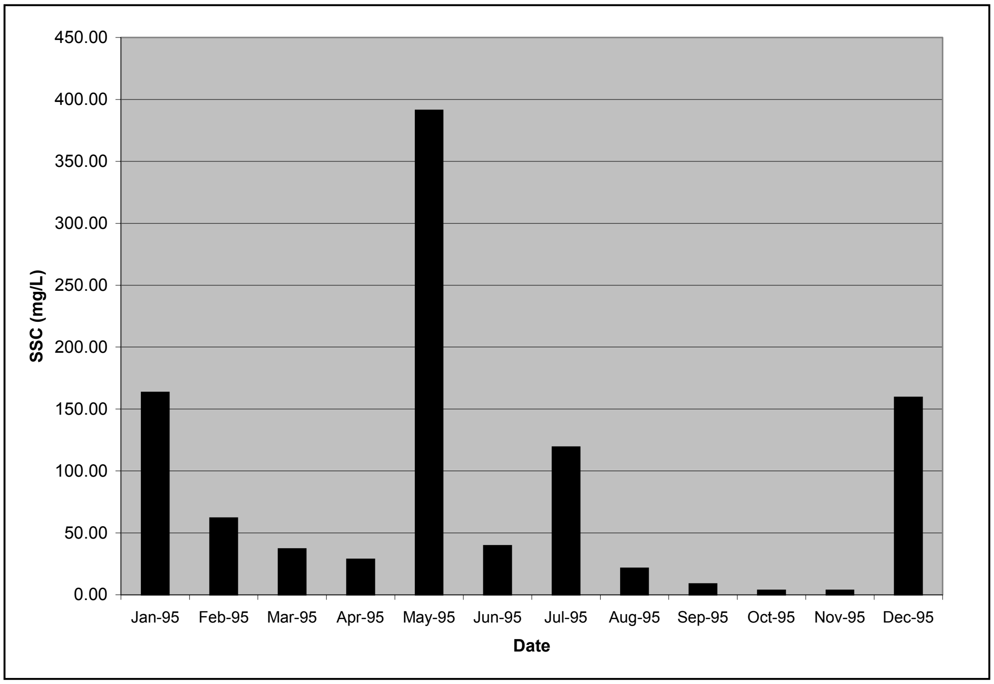

Figure 2.36 1995 Suspended Sediment Monthly Geometric Mean at the Reynolds Creek Experimental Station Outlet Gauge

As can be seen in Figure 2.36, the SSC in Reynolds Creek fluctuate with climate-related precipitation and are not closely linked to the irrigation season (April – September). Sediment concentrations during low flow periods of the year are nearly two orders of magnitude lower than during run-off periods, which include storm events (Pierson et al. 2000). Concentrations increase in the autumn as more precipitation begins to fall. They remain high through January but tend to decrease as snow begins to accumulate. The peak concentrations occur during the peak run-off period and then concentrations decrease and stabilize for the remainder of the year. The peak run-off period in the Reynolds Creek drainage is typically May, but can occur as early as late-March in a warm year. In those years the peak suspended sediment concentrations fluctuate accordingly. The increase in concentration that occurred in July 1995 was likely due to an extended precipitation event.

The data from the RCEW outlet station and land use information for Reynolds Creek below the Bernard Ditch indicate that nearly the entire sediment budget can be contributed to climactic events and the associated run-off, not anthropogenic sources.

Fisheries

No fisheries data were located for Reynolds Creek below the Bernard Ditch. However, anecdotal information from a local landowner indicates that trout have occasionally been harvested from the stream below the Bernard Ditch (Brandau 2002). The presence of young of the year trout, an indicator of spawning success, cannot be documented. Surveys performed in 1997 located wild redband trout above the community of Reynolds (Allen et al. 1998). Idaho Fish and Game fisheries biologists performed these surveys for the Bureau of Land Management and captured and identified 26 wild redband trout including young-of-the-year fish. These data suggest that redband trout spawn in Reynolds Creek above the Snake River Plain. However, information does not exist to show whether redband trout spawn below the Bernard Ditch.

Aquatic Insects (Macroinvertebrates)

Macroinvertebrate samples were collected from Reynolds Creek at two locations in 1995 and two locations in 1998 as part of the DEQ BURP process. The 1995 data were collected near the community of Reynolds, in the upper portion of the watershed. The 1998 data were collected near Highway 78, in the segment of stream §303(d) listed for sediment. Table 22 shows that SMI score and the associated condition rating for each.

Table 22. Stream macroinvertebrate index (SMI) scores for samples collected from Reynolds Creek in 1995 and 1998.

Site ID	Sampling Location	SMI	Condition Rating	Support Status Based on SMI
1995SBOIA23	Above Reynolds Creek	56.23	3	Full Support
1995SBOIA24	Above Reynolds Creek	55.88	3	Full Support
1998SBOIA24	At mouth of lower Canyon Creek	50.42	2	Full Support
1998SBOIA25	Directly above Highway 78	47.69	2	Full Support

The SMI scores indicate there is a good diversity of aquatic insects in Reynolds Creek. Additionally, the abundance of EPT taxa, an indicator of good water quality, is 38% at the mouth of the lower canyon (1998SBOIA24) and 45% directly above Highway 78 (1998SBOIA25). For the basin in which Reynolds Creek is located, these are acceptable EPT taxa values.

Status of Beneficial Uses in Reynolds Creek

The data indicate that sediment is not impairing cold water aquatic life or salmonid spawning beneficial uses in Reynolds Creek. Consequently, DEQ does not recommend preparing a TMDL for sediment and recommends removing sediment as pollutants of concern in Reynolds Creek from the §303(d) list. Table 23 summarizes the beneficial use support status for Reynolds Creek.

Table 23. Status of Beneficial Uses in Reynolds Creek

Segment	Designated Uses	Impaired Use	Pollutants Causing Impairment
Bernard Ditch to Snake River	Cold Water Aquatic Life, Salmonid Spawning, Primary Contact Recreation	None	None

Sinker Creek

This section describes the physical, chemical and biological data for the listed segments of Sinker Creek.

Surface Hydrology
Sinker Creek is listed for sediment and temperature from below Diamond Creek to the Snake River. This segment of Sinker Creek is de-watered near the Snake River, with the de-watered segment extending from the Snake River to 1.5 miles upstream. Ranch managers report that the creek periodically (some years, but not every year) dries up in the section between Sinker 2 and Sinker 3 (as identified in Figure 2.38). From Diamond Creek downstream to this de-watered section flows typically run between 2-4 cfs during the summer months, as shown in Figure 2.37. The flow is regulated by Hulet Reservoir and irrigation activity. The presence of the reservoir appears to minimize the scouring effect of extreme flow events.

In addition, the effects of beaver ponds can be seen throughout the reach. The ponds act as sediment sinks and also increase channel width by backing water up, causing increases in temperature. These ponded areas, the reservoir, flow alteration and high air temperatures all contribute to high instream temperatures during the critical period from June 21 through September 21. As part of implementation the effects of beavers will be more quantitatively documented. However, in the reach between Diamond Creek and 1 mile below Hwy 78, DEQ staff documented 30 ponded areas. While many of these areas were not being actively used, the water was ponded up and the width of the stream greatly increased by the dams. Temperature increases are expected in these areas. In addition, the riparian area in a portion of these areas is suboptimal due to heavy beaver use. Beavers, in general, are beneficial to riparian area, however in the short term, they may put extreme pressure on the riparian area. There is livestock grazing in this area, in general from 2-4 weeks in March with infrequent sporadic light use thereafter.

Stream surveys by DEQ personnel showed that overall the system displays good biological integrity with a few isolated problem areas.

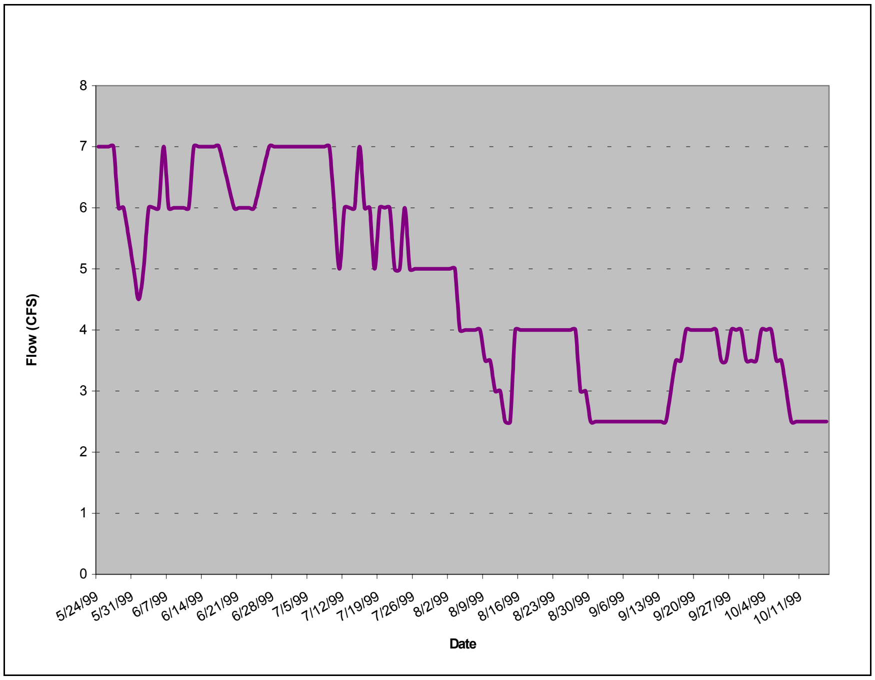

Figure 2.37 Water Year 1999 Flow, Sinker Creek at Joyce Ranch (T3S R1W S30)

Temperature and Other Physical Data

Thermographs were placed at three locations in Sinker Creek by DEQ staff in the winter of 2002, as shown in Table 24 and Figure 2.38. Temperature readings were collected every hour and 12 minutes through mid-September in order to characterize temperature trends and temperatures during the hottest part of the year. The Sinker 3 thermograph serves as the compliance point for temperature since that logger was directly above the diversion. Below the diversion, flows fall below 1 cfs by the end of June and remain such through the rest of the irrigation season.

Table 24. Sinker Creek thermograph location.

Thermograph	Location
Sinker 1	T3S R1W S 30
Sinker 2	T3S R1W S 21
Sinker 3	T3S R1W S 13

Data from July 11-13 were above the maximum weekly maximum temperature (MWMT) (101.73 °F using Grand View station National Climactic Data Center data from 1971-2000, following WBAG II (Grafe et al 2002) protocol) and those data were excluded from the analysis. During the critical period from June 21-September 21, at the compliance point (Sinker 3), 20% of the days had water temperatures above the 19 °C maximum daily average as shown in Figure 2.40. These periods corresponded to both the periods of highest ambient air temperatures and lowest flows. Sinker 1, about 2 miles below the top of the listed reach, met water quality standards as shown in Figure 2.39. There are over 30 ponded areas due to beaver dams between Sinker 1 and Sinker 2. These areas resulted in overall warmer temperature increases than between Sinker 2 and Sinker 3. In fact, at certain times of the summer, Sinker 3 showed cooler temperatures than Sinker 2. This may be because of the flow contribution by springs below Sinker 2.

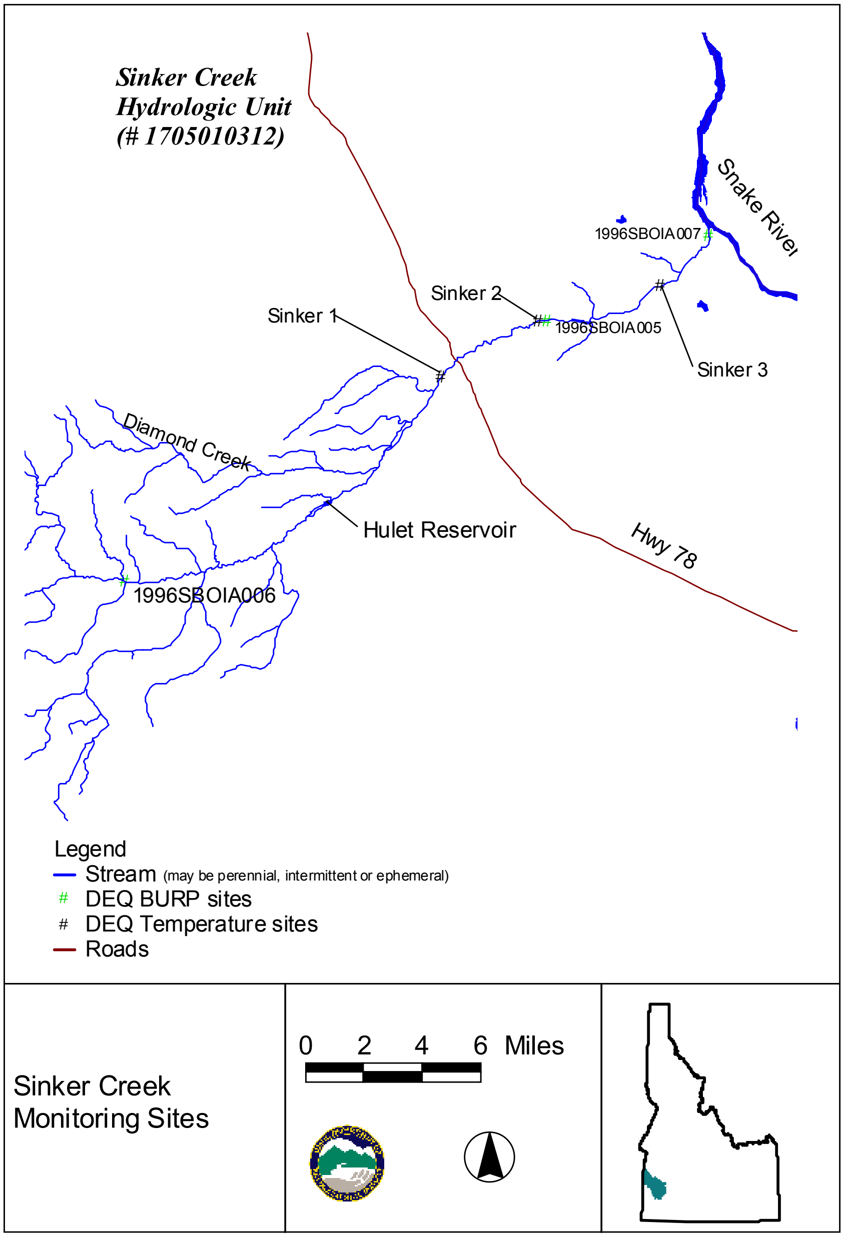

Figure 2.38 Sinker Creek Monitoring Sites

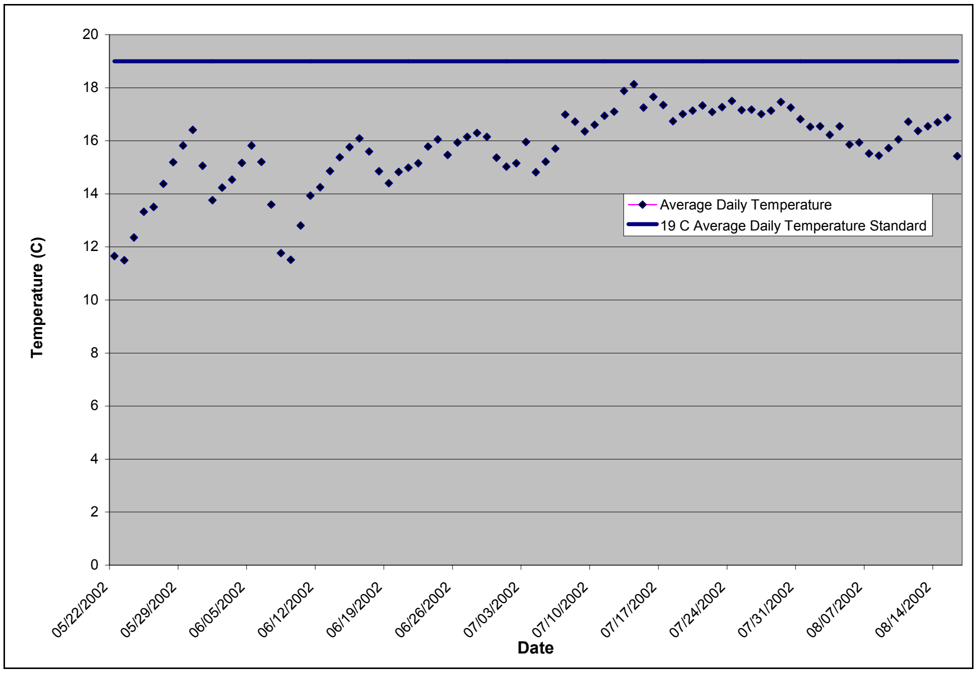

Figure 2.39 Comparison of Sinker Creek Average Daily Temperatures at Sinker 1 to Cold Water Aquatic Life Maximum Daily Average Temperature Standard

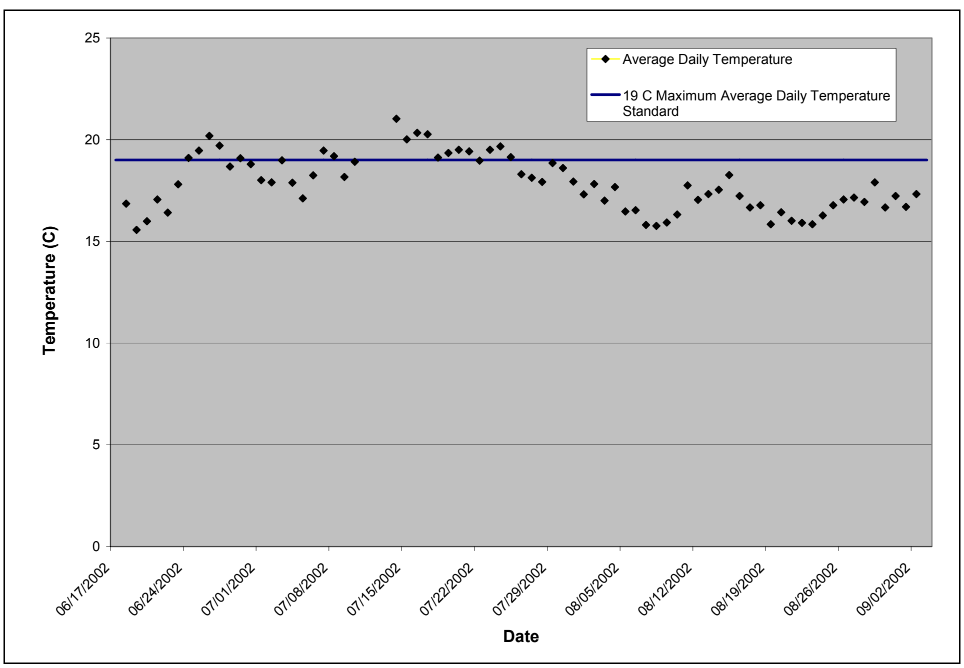

Figure 2.40 Comparison of Average Daily Temperature at Sinker 3 with Cold Water Aquatic Life Maximum Average Daily Temperature Standard

Sediment

A riparian survey by the Idaho Soil Conservation Commission showed high impacts to the riparian area in the listed section. However, sediment surveys of Sinker Creek south of Highway 78 showed little impact to the channel, and thus, to aquatic life from grazing activity. The BLM has collected proper functioning condition data for Scotch Bob Creek (a tributary to Sinker Creek) and the upper reaches of Sinker Creek. The proper functioning condition data indicate that the riparian areas in these sections are in unsatisfactory condition. PFC condition ratings may indicate either an upward, static or downward trend. An analysis of the riparian condition of pastures showed that the middle section of the listed reach was in satisfactory condition. The parts of the reach closer to the mouth, which get significantly de-watered, were listed as unsatisfactory (BLM-Owyhee RMP 1999).

Based on this information, DEQ determined that the majority of sediment delivery was from instream channel erosion in the listed section. Hulet Reservoir above the section effectively acts as a sediment sink for the majority of sediment delivered from upstream.

DEQ staff conducted channel erosion inventories in 2002 to assess sediment loading from instream erosion. In order to extrapolate measurements to the rest of the listed reach, the inventory sections were delineated by land use. Representative segments were evaluated for stream erosion and then those results extrapolated to the rest of the system. Appendix H contains the bank erosion inventory worksheets and the TMDL section of this document contains further discussion of the results. Additional bank stability data collected as part of DEQ's BURP program are located in Table 25.

Gully erosion occurs in the Sinker Creek subwatershed due to the combination of steep terrain, erodible soils, and occasional severe rain events. Gullies that were readily apparent in aerial photos were assessed in the field by DEQ staff in order to quantify sediment contribution. One gully was identified as a sediment contributor from aerials but a ground survey showed that an earthen berm had been constructed at the bottom to catch water and sediment. While not stopping the gullying action, the berm was stopping contribution of sediment to Sinker Creek and was therefore not assessed. Any land management practices exacerbating the gullying action need to be examined during implementation to prevent a huge bolus of sediment laden water from either going around the berm or breaking through it. The berm itself appears to be made up of largely unconsolidated soil material.

Table 25. Sinker Creek Bank Stability

Data Type[1]	Year Collected	Site	% Fines	Bank Stability
BURP SMI/Upper Sinker Creek 96SWIROA6	6/6/96	Lat: 43 03 51.70 Long: 116 38 3.70	28.3%	100%
BURP SMI/Middle Sinker Creek 96SWIROA5	6/6/96	Lat: 43 09 14.94 Long: 116 26 58.09	52.2%	99%
BURP SMI/Lower Sinker Creek	6/6/96	Lat: 43 10'58.98 Long: 116 22 44.38	78.4%	50%

[1]BURP = Beneficial Use Reconnaissance Program, SMI = stream macroinvertebrate index
Shading indicates electrofishing took place in listed section of Sinker Creek.

Fisheries

Fisheries data show spawning redband trout populations above Hulet Reservoir. Below the reservoir, in the §303(d) listed section, no young-of-the-year redband have been found. This is likely due to a combination of factors relating to flow alteration, lack of spawning habitat due to stream characteristics, and barriers to fish migration due to Hulet Reservoir. Table 26 show the fisheries data for Sinker Creek.

Table 26. Fisheries Data for Sinker Creek

Data Type[1]	Date	Location	Fish
IDFG	Summer 1976	Sinker Creek at Silver City Road Crossing	7 redbands/100m^2
DEQ-BURP	6/14/95	Sinker Creek above Hulet Reservoir T4S R2W S15 T4S R3W S24	Redbands (80-210 mm) Dace
DEQ-BURP	6/15/95	Sinker Creek, 0.5 miles below Highway 78 T3S R1W S29	2 redbands (197 and 223 mm), dace, bridgelip sucker
IDFG	August 1996	Sinker Creek at Silver City Road Crossing	34 redbands/100 m^2
IDFG	Spring 2001	T3S R1W S29	Redbands (age 2 and older)
IDFG	Summer 2002	T3S R1W S29	2 redbands (no young-of-the-year)

[1]IDFG = Idaho Department of Fish and Game, DEQ-BURP = Department of Environmental Quality Beneficial Use Reconnaissance Program
Shading indicates electrofishing took place in listed section of Sinker Creek.

Macroinvertebrates

No coldwater indicators were found in any of the macroinvertebrate samples collected by DEQ. The macroinvertebrate index score for middle Sinker Creek was in the 10th-25th percentile of the expected reference condition for streams in this basin while upper Sinker

Creek was above the 25th percentile of reference condition. Lower Sinker Creek was below the minimum threshold of reference condition but these macroinvertebrate results are of little utility for cold water aquatic life use determination since that section of stream is normally dry during the critical period from June 22 to September 21. The macroinvertebrate sampling occurred prior to the critical period for this section of stream. Table 27 shows the macroinvertebrate data for Sinker Creek.

Table 27. Macroinvertebrate data for Sinker Creek.

Data Type[1]	Year Collected	Site	SMI[2]
BURP SMI/Upper Sinker Creek 96SWIROA6	6/6/96	Lat: 43 03 51.70 Long: 116 38 3.70	67
BURP SMI/Middle Sinker	6/6/96	Lat: 43 09 14.94 Long: 116 26 58.09	46.74
BURP SMI/Lower Sinker Creek	6/6/96	Lat: 43 10’ 58.98” Long: 116 22’ 44.38	19.65

[1]BURP = Beneficial Use Reconnaissance Program, SMI = stream macroinvertebrate index
[2]Stream macroinvertebrate index
Shading indicates electrofishing took place in listed section of Sinker Creek.

Status of Beneficial Uses
Initially, the 1996 BURP data used in the water body assessment process indicated full support of beneficial uses in the upper and middle reaches. In the lower reach the assessment process indicated that beneficial uses were not fully supported. However, it is important to note that this section is de-watered during the critical period. Low macroinvertebrate scores are to be expected.

While Sinker Creek is listed for salmonid spawning, there is no evidence of redband spawning in this reach. Young-of-the-year have not been found in past electrofishing efforts and only a few adult redbands were found. Idaho Department of Fish and Game fisheries data show redbands higher in the watershed above Hulet Reservoir.

The Idaho Department of Fish and Game has determined that the listed section of Sinker Creek has not historically, nor is currently, a spawning habitat due to gradient and temperature regimes (Dillon 2002). IDFG further states that this section of Sinker Creek is currently and has also in the past been primarily a migratory corridor (Appendix F). The reservoir and the various diversions also serve as barriers to fish migration to the downstream section for spawning. The storage of water in the reservoir as well as the de-watering of the stream result in higher water temperatures, but it is unlikely that changes in management activities would result in lowering water temperatures to salmonid spawning criteria due to the overriding effect of high ambient air temperatures and flow alteration activities.

Since salmonid spawning does not occur in the listed section of Sinker Creek, the temperature standard for salmonid spawning will not be applied and instead the cold water temperature standard will apply throughout the year. The lower end of Sinker Creek (Sinker 2 thermograph) has shown temperature violations and thus, cold water aquatic life uses are not fully supported. Salmonid spawning occurs in the upper reach (the unlisted section) and IDFG data showed an increase in young of the year populations in their 1995 fish surveys, indicating support of spawning in the upper reaches (IDFG 1997).

Overall, Sinker Creek supports beneficial uses in some areas and not in others. Sediment is above the 28% fines target and the temperature standard is not met in the lower reaches.

Conclusions

The data show that aquatic life beneficial uses in Sinker Creek are not fully supported and a TMDL is recommended for temperature and sediment.

Squaw Creek

This section describes the physical, chemical and biological data for the listed segments of Squaw Creek.

Surface Hydrology

Squaw Creek is listed from headwaters to mouth for temperature. Squaw Creek goes dry or reaches a base flow of less than 1 cfs before or during July every year by the time it reaches the “Cut-off Road” below the canyon (Squaw 2, see Table 28 for location) (DEQ 1995, 2002). In 2002, flows dropped below 1 cfs before June 21 (the start of the critical period for cold water aquatic life). In the upper reaches, perennial pools exist and there are refugia within the stream that will support fish populations. A private reservoir in the upper reach of Squaw Creek has been stocked in the past, resulting in fish in the upper reach. Low flows make Squaw Creek more susceptible to peak temperatures due to the influence of both air temperature and solar radiation. Riparian improvements would provide some benefit to stream quality but not to a large enough degree to prevent heating of the water above the standard during times of extremely hot weather. Squaw Creek is proposed for de-listing of temperature because beneficial uses are supported when there is water above 1 cfs.

Temperature

In spring 2002, temperature loggers were installed by DEQ in five locations in Squaw Creek from close to the headwaters to within 0.5 miles of the Snake River. The locations of the temperature loggers are shown in Table 28. When there was water above 1 cfs in the creek, average daily temperatures were below 19 °C. The Squaw 3 thermograph was used as a compliance point because this portion of the creek appears to have perennial flow, while Squaw 2 was completely dry by mid-July. As shown in Figure 2.41, temperature standards are met in Squaw Creek when there is sufficient flow and, thus, a TMDL is not necessary.

Table 28. Temperature logger location in Squaw Creek.

Temperature Logger I.D.	Location
Squaw 1	T2N R4W S35
Squaw 2	T1N R4W S8
Squaw 3	T1N R5W S25
Squaw 4	T1S R5W S13
Squaw 5	T1S R5W S30

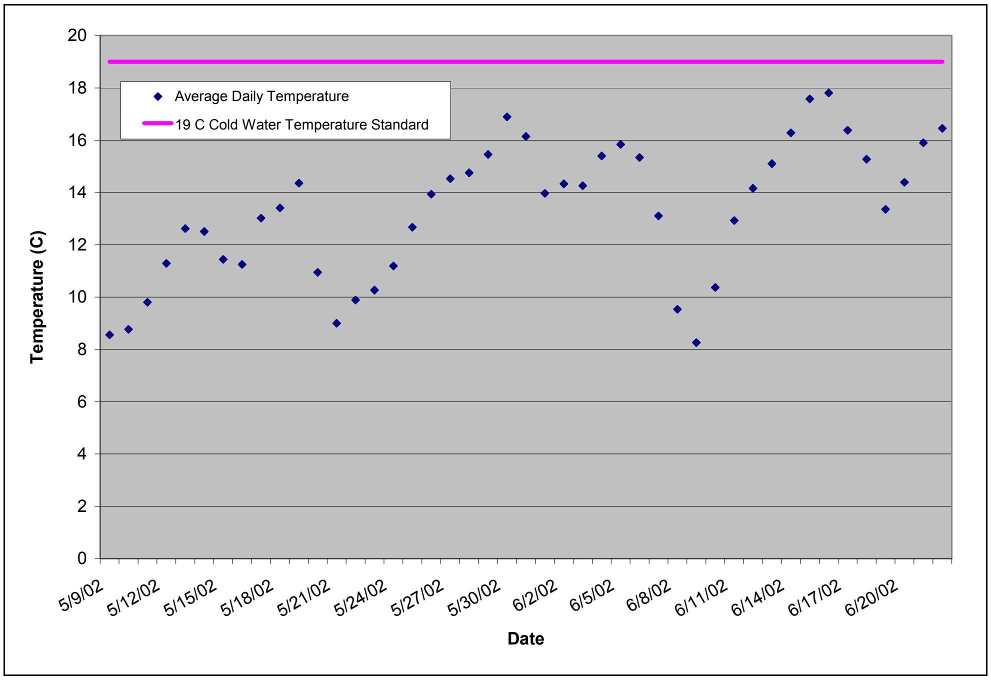

Figure 2.41 Average Daily Temperatures in Squaw Creek at Squaw 3 Thermograph

Sediment

The segment of Squaw Creek listed for sediment (3.9 km upstream or river to mouth) runs primarily through pastureland and uncultivated scrub (rangeland). Low sinuosity and low gradient characterize this reach. The upper half of this section is largely dry after early June due to lack of flow: water subs out into the gravels and is diverted out of the reach. Water remains in the lower half due to contributions from springs and pasture runoff. However, the flow is typically less than 1 cfs. Flow had already dropped to 0.16 cfs in early May 2002.

Instream channel erosion was not considered since generally the creek is dry or less than 1 cfs except during peak runoff events. There is no agricultural return water diverted back into the creek. Most of the irrigation in this listed reach of Squaw Creek is on permanent pasture and is done primarily by sprinkler. Flood irrigation takes place early in the year when there is adequate runoff to fulfill the water right and water returns to the creek via subsurface laminar flow and overland flow. The runoff from pastures is generally not sediment-laden due to the filtering action of the plants. Suspended sediment concentration samples were taken and the results are shown in Table 29.

Table 29. Total suspended solids concentrations in Squaw Creek at Highway 78.

Sampling Date	Suspended Sediment Concentration (mg/L)
7/17/02	15
8/2/02	8
8/15/02	9.2
9/4/02	4.9

Suspended sediment concentration levels are far below the maximum 50 mg/L target in place on the Snake River. This target is based on work by Newcombe and Jensen (1996) and is protective of juvenile as well as adult salmonids. Thus, this target is protective of the presumed cold water beneficial uses in Squaw Creek. Sediment is not impairing beneficial uses in this reach.

Conclusion
DEQ proposes to de-list Squaw Creek for sediment and temperature; a TMDL is not required.

Succor Creek

This section describes the physical, chemical and biological data for the listed segments of Succor Creek. For purposed on analyzing and discussing the data, Upper Succor Creek is defined as the headwaters to the Oregon Line. Lower Succor Creek is defined as the Oregon Line to the Snake River. Tables 2.43 and 2.44 show the boundaries of each.

Surface Hydrology

In most years Succor Creek is perennial in both the upper and lower segments. The upper segment is considered perennial due to the presence of naturally occurring pools that support aquatic life (as per the Idaho Water Quality Standards). However, in normal water years the stream contains no discernible flow between the pools after the spring run-off period. Figures 2.42 and 2.43 show pictures of the stream as it typically appears between the perennial pools. There are four adjudicated diversions above Succor Creek Reservoir. Otherwise, the hydrology of upper Succor Creek has not been significantly modified over time. Below the reservoir, the stream flows continuously due to discharge from the reservoir. Although in 1992, the driest year on record in many portions of Idaho, the stream was dry below the reservoir. Lower Succor Creek has been hydrologically modified for agricultural related purposes. Similar to Jump Creek, the soils in the subwatershed became saturated as the lands adjacent to the stream were irrigated as cropland. As irrigation continued, the ground water level increased and began to interfere with soil and crop health. In response, drains were constructed and the existing channel was deepened to drain the excess groundwater.

There is not a significant amount of flow data for lower Succor Creek, but enough exists to accurately characterize the stream's seasonal flow fluctuation in the segment. Figure 2.44 shows the typical discharge rates in lower Succor Creek near Homedale (IDA 2001). The hydrograph is typical for a system that is influenced by the irrigation season (April–September). The base flow period extends from November through February. The flow increases in March and April as spring run-off occurs and irrigation water is added to the system. Flows are relatively similar throughout the summer and eventually return to base flow as the irrigation season comes to an end.

Due to the irrigated nature of the lands adjacent to lower Succor Creek, a network of canals, laterals, and diversions exist within the system. Within the 5.4-mile stretch of stream that extends from the Oregon line to the Snake River, there are approximately five agricultural return drains and one major withdrawal (Patch Canal). Sage Creek, which enters lower Succor Creek 1.6 miles upstream from the Snake River, is the largest of the agricultural return drains. Lower Succor Creek is not de-watered to the extent of some other tributaries in the basin. All of the water removed from lower Succor Creek is used for agricultural purposes.

Figure 2.42 Upper Succor Creek below Cottonwood Creek, October 17, 2003

Figure 2.43 Upper Succor Creek below Cottonwood Creek, October 17, 2003

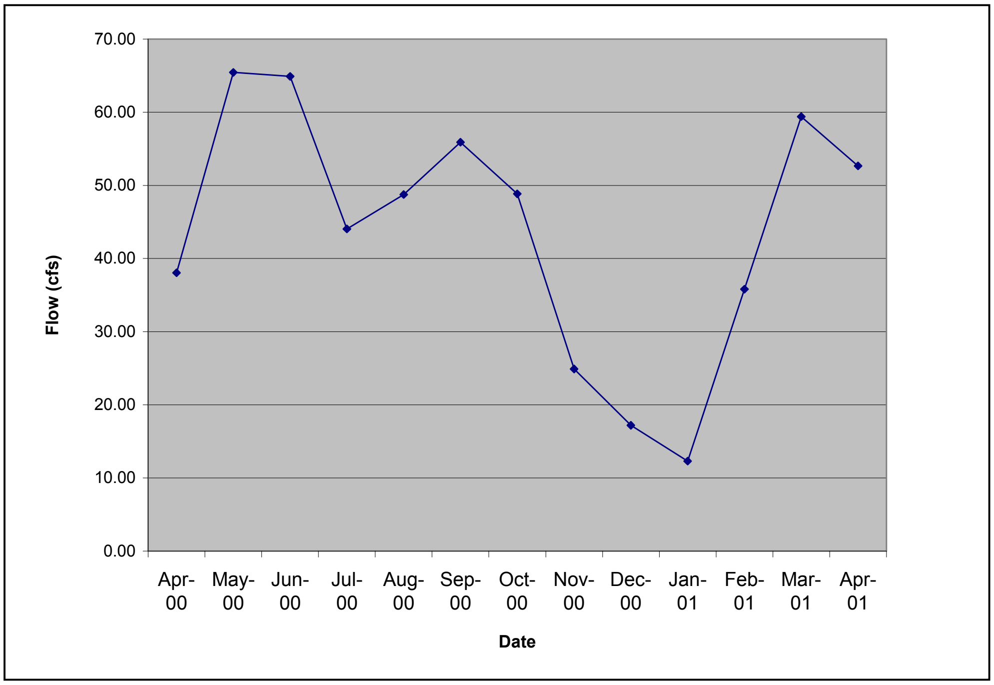

Figure 2.44 Typical Monthly Flows in lower Succor Creek Near Homedale (2000-2001)

The flow data available for upper Succor Creek is limited to flows collected as part of the DEQ BURP surveys in various years and 2002 field surveys. Table 30 shows the flows at selected locations in upper Succor Creek during 1994, 1995, and 2002.

Table 30. Flows in upper Succor Creek.

Location	Date	Flow (cfs)
0.92 miles upstream from reservoir	6/2/94	7.31
0.92 miles upstream from reservoir	6/7/95	31.5
0.92 miles upstream from reservoir	6/19/02	14.77
0.92 miles upstream from reservoir	8/21/02	0
6.70 miles upstream from reservoir	6/2/94	6.32
6.70 miles upstream from reservoir	6/6/95	27.3
6.70 miles upstream from reservoir	8/1/95	0.43
9.70 miles upstream from reservoir	5/20/02	19.67
9.70 miles upstream from reservoir	7/1/02	2.24
9.70 miles upstream from reservoir	8/21/02	0

As illustrated in Table 30, the flows in upper Succor Creek are largely influenced by the water year. The flow directly above the reservoir was 7.31 cfs in June 1994, a year of low snow pack. The following year (June 1995), the snow pack was much higher and the subsequent stream flow was nearly four times that of 1994. This wide range of annual flow conditions is typical for streams in Owyhee County.

Succor Creek Reservoir (located in upper Succor Creek)
Succor Creek Reservoir is located in Idaho approximately 4.4 miles upstream of the Oregon border. Completed in 1979, the reservoir was constructed primarily to hold water late into the growing season for agriculture below the reservoir. The capacity of the reservoir is 6,400 acre-feet and in most years, the reservoir reaches capacity. Active withdrawal typically begins in May or June as the need for water below the reservoir becomes necessary; however, the dam construction allows for open spill from the surface of the reservoir when water is not being withdrawn. The active withdrawal point in the dam is near the bottom, although the exact distance from the top of the dam is unknown. The water depth at the dam during full pool is between 80 and 90 feet. Normally, a 40-foot minimum pool is kept throughout the year, unless the pool is reduced to maintain the headgate. Flow data provided by the Succor Creek District Improvement Company shows that an average inflow between 5/27/02 and 6/23/02 of 14.18 cfs. This flow closely corresponds with measurements taken by DEQ on 6/19/02. The flow was 14.77 cfs less than a mile above the reservoir. The Succor Creek District Improvement Company data also show an average reservoir outflow of 42.26 cfs for the period of 5/27/02 to 8/16/02. These data illustrate the managed, unnatural flows that occur below the reservoir.

Water Column Data
DEQ and the Idaho Department of Agriculture (IDA) have collected water column data over the past three years. The water column monitoring locations have primarily been below the Oregon State line on lower Succor Creek while the temperature and habitat (sediment) locations have been above the Oregon State line in upper Succor Creek. Figures 2.45 and 2.46 show the monitoring locations. Note that Succor Creek originates in Idaho, flows into Oregon and then re-enters Idaho near Homedale. The monitoring data from directly below the reservoir in Figure 2.45 consists only of instantaneous temperature data used to populate the SSTEMP temperature model used to develop the temperature TMDL.

Bacteria (E. Coli)
While bacteria is not a §303(d) listed pollutant in Succor Creek, there is a significant amount of recent data indicating that *E. Coli* is in excess in the lower Succor Creek (Oregon State line to Snake River). The IDA collected *E. Coli* data throughout most of 2000 and into 2001. The data were collected above and below Sage Creek, which enters lower Succor Creek 1.6 miles upstream from the Snake River. Data were also collected from Sage Creek. There are no data available for upper Succor Creek.

Figure 2.47 shows the *E. Coli* concentrations in lower Succor Creek above and below Sage Creek. All but ten samples exceed the instantaneous criterion of 406 organisms/100 mL. The geometric mean could not be calculated because five samples were not collected over a 30-day period. However, the magnitude of the *E. Coli* concentrations and the consistency with which the exceedances occur (all but ten samples exceeded the criterion) suggest that had the data been collected the geometric mean criterion (126 organisms/100 mL) would likely have been exceeded.

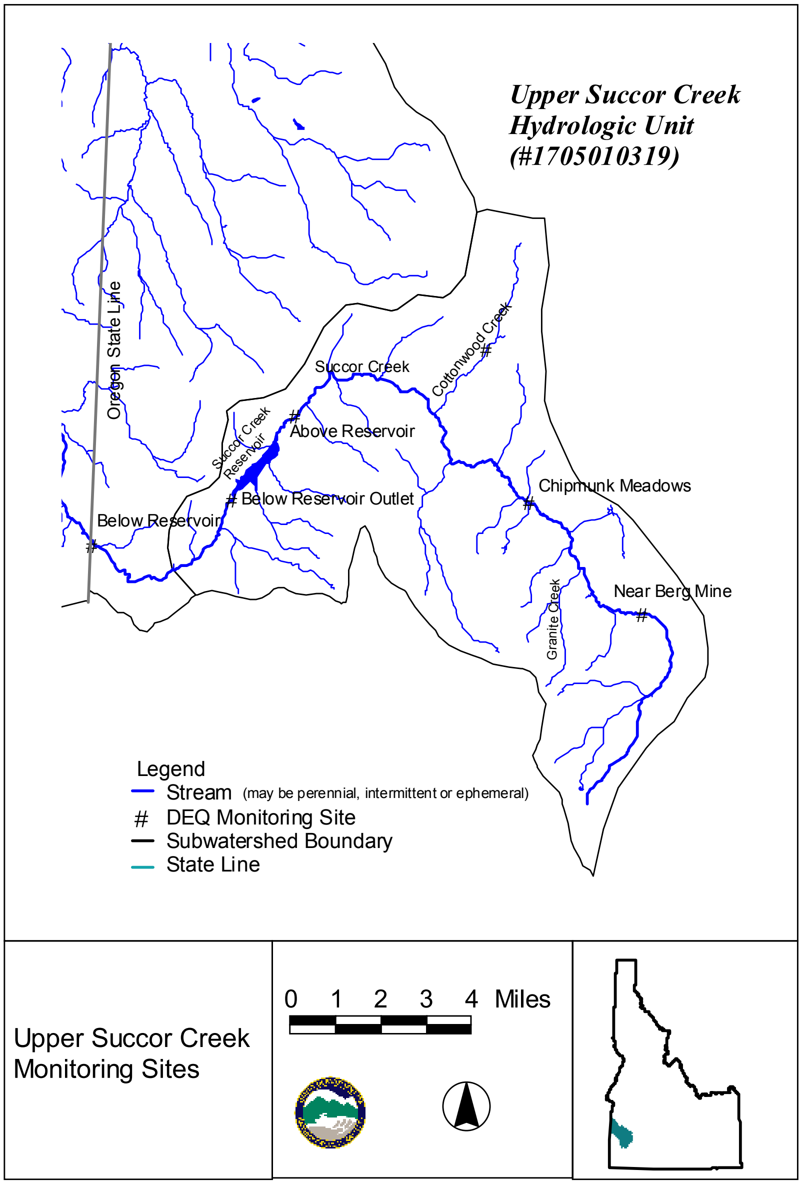

Figure 2.45 Upper Succor Creek Temperature Monitoring Sites

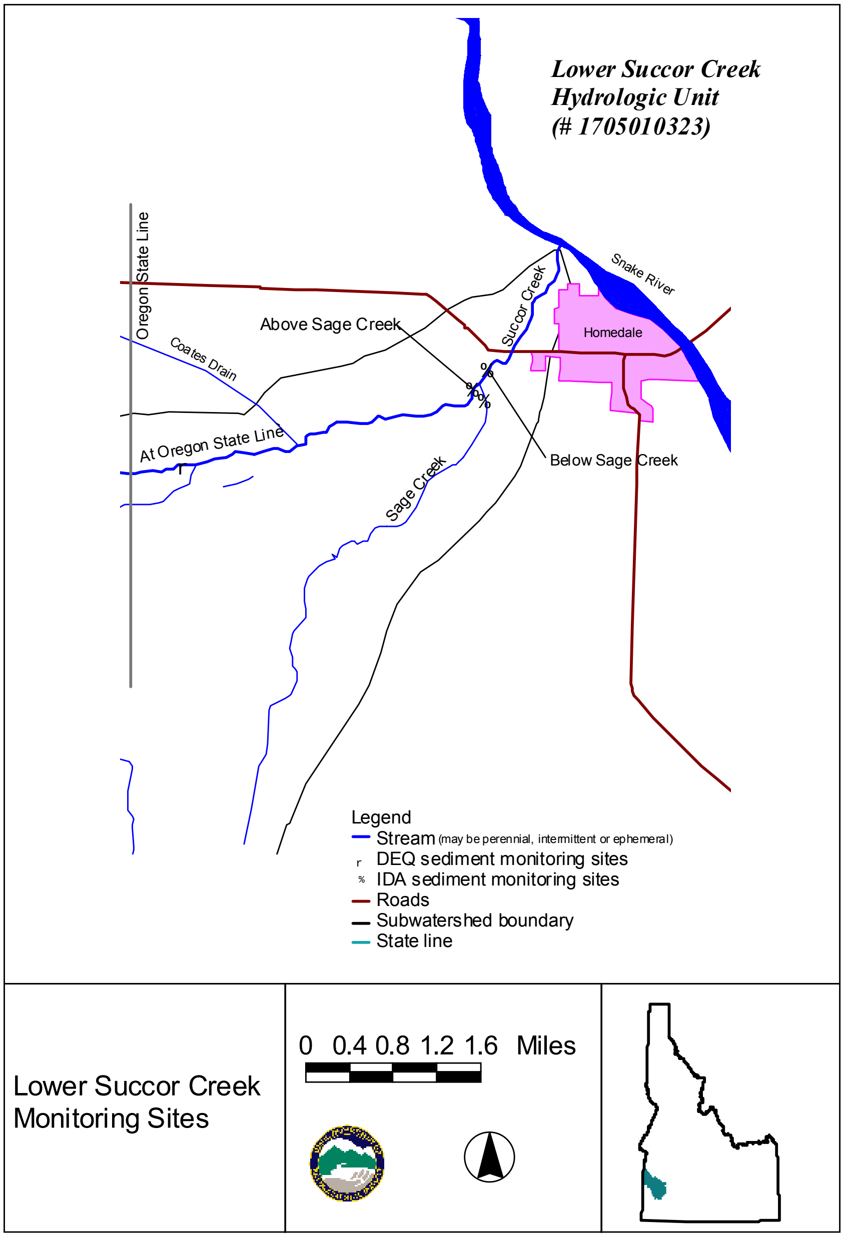

Figure 2.46 Lower Succor Creek Sediment Monitoring Sites

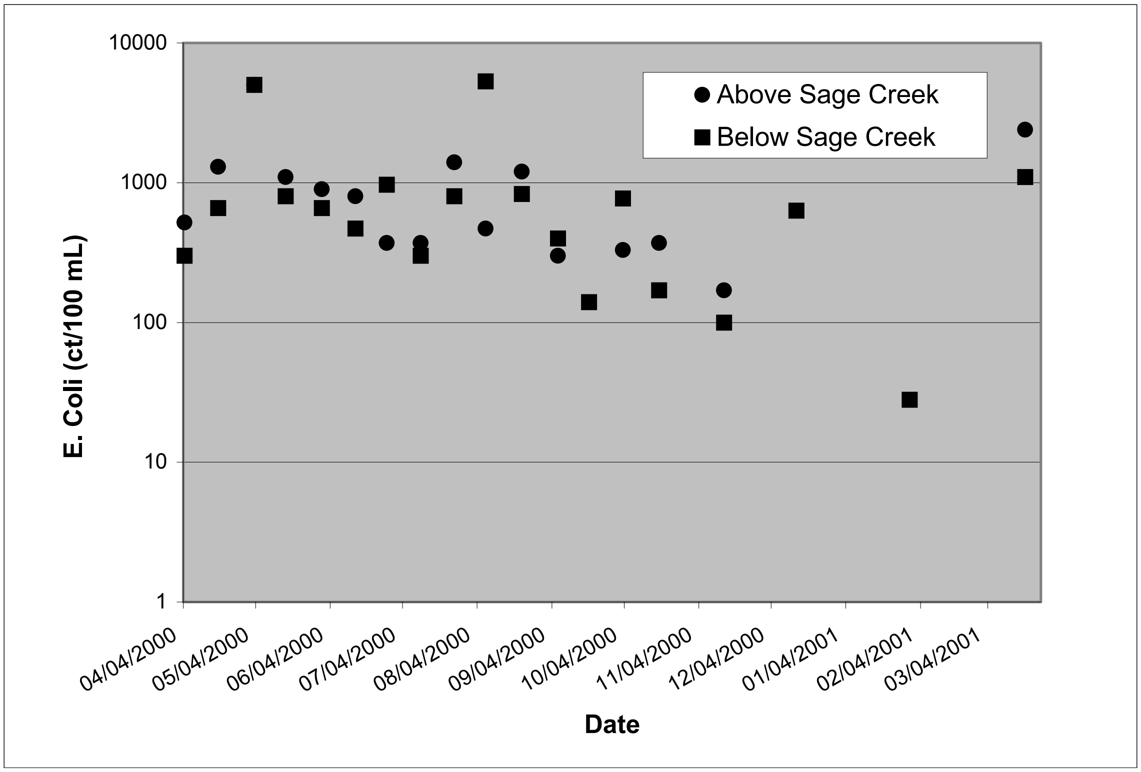

Figure 2.47 *E. Coli* Concentrations in lower Succor Creek, Above and Below Sage Creek

In August 2001, DEQ collected *E. Coli* samples near Homedale as part of the BURP program. Four samples were collected over a 17-day period starting at the first of the month. Again, five samples were not collected over 30 days, but the geometric mean of the four samples collected over 17 days was 794 organisms/100 mL. Even if the fifth sample were to have been 0 organisms/100 mL, the geometric mean would still have been greater than the 126 organisms/100 mL standard. The concentrations of the first four samples were 580; 580; 3,700; and 320 organisms/100 mL. Based on these concentrations, it seems unlikely that the fifth sample would have been even close to 0 organisms/100 mL.

Sediment

The IDA collected water column sediment data from lower Succor Creek and Sage Creek in 2000 and into 2001 in support of the Succor Creek constructed wetlands project. The sediment parameter sampled was TSS. In addition, in 2002 DEQ collected irrigation season TSS data directly below the Oregon line. The sediment sample sites can be seen in Figure 2.46. There are no water column sediment data available from upper Succor Creek, but visual surveys of the water during the 2002 field season suggest that water column concentrations are low above the reservoir. At all locations the stream bottom was visible, even during the spring runoff period. Figure 2.48 shows a dated photograph of the water column and substrate near Berg Mine. Note the good water clarity and good distribution of substrate material.

Figure 2.48 Water Column and Substrate Quality near Berg Mine on May 20, 2002

As shown in Figure 2.49, the irrigation season sediment load from Sage Creek has a marked effect on the TSS concentration in lower Succor Creek near Homedale. Directly above Sage Creek, the average irrigation season concentration is 22 mg/L. Below Sage Creek, the concentration increases to 83 mg/L. The monitoring locations are located directly above and below Sage Creek. Therefore, the increase in concentration below Sage Creek can be primarily attributed to Sage Creek. The TSS loads follow the same trend as the concentrations, as illustrated in Figure 2.50.

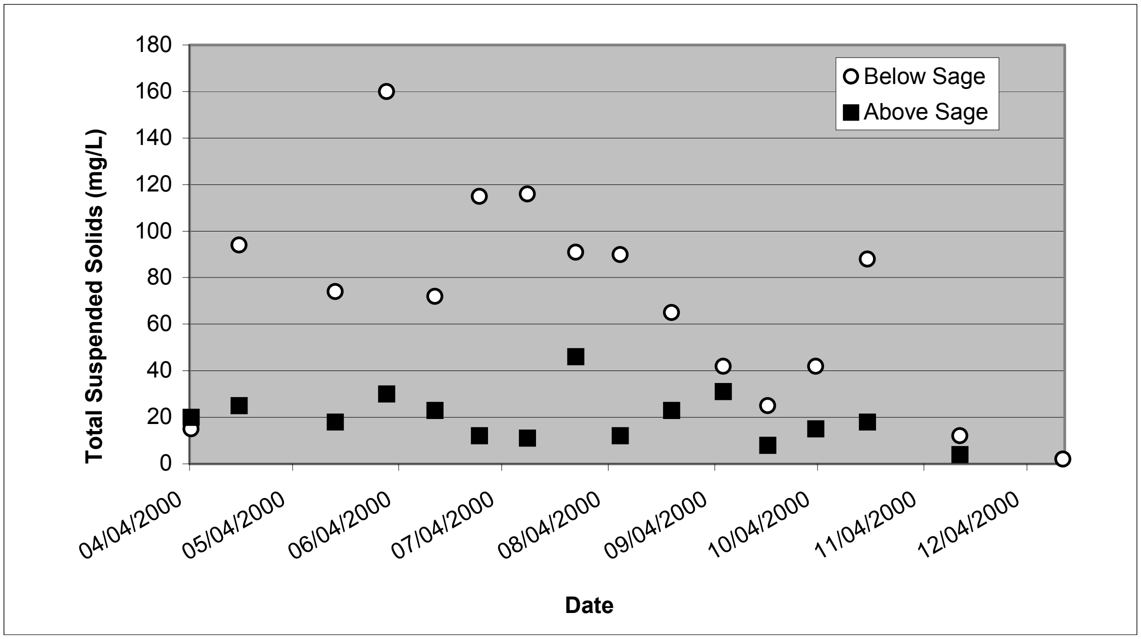

Figure 2.49 Total Suspended Sediment Concentrations in lower Succor Creek Above and Below Sage Creek

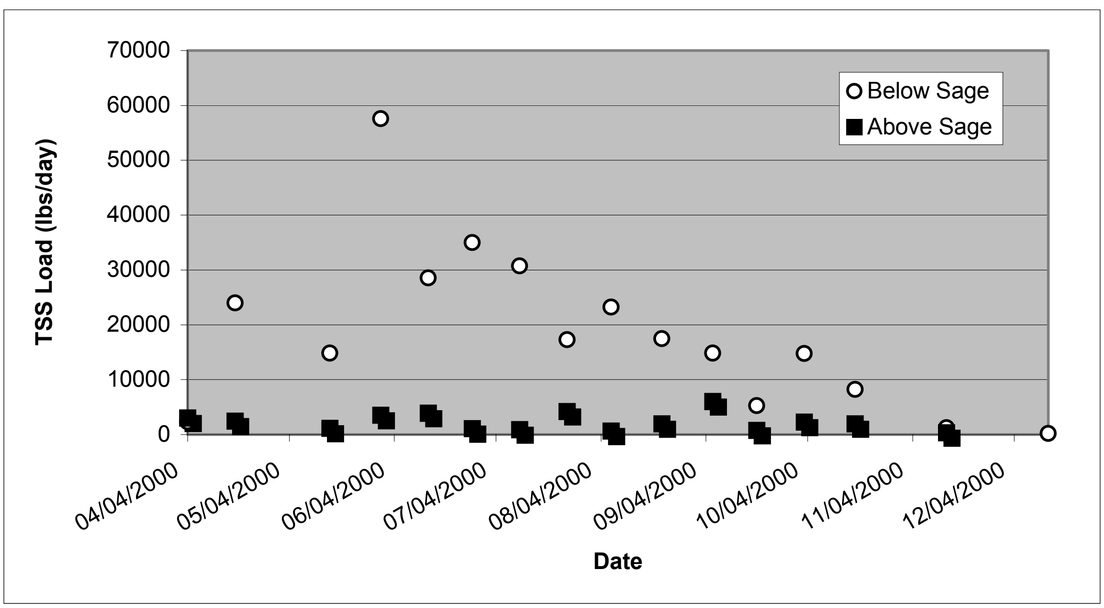

Figure 2.50 Total Suspended Solids Loads in lower Succor Creek Above and Below Sage Creek

Above Sage Creek the irrigation season and non-irrigation season TSS concentrations are very similar (22 and 12 mg/L, respectively). At the Oregon line the irrigation season TSS concentration is 16 mg/L. The irrigation season increase from 16 mg/l at the Oregon line to 22 mg/L above Sage Creek suggests that while there is a measurable increase in TSS concentration, it is not significant (only 5 mg/L).

Sediment Condition Assessment

As illustrated in Table 6, the Idaho water quality standard for sediment is narrative, meaning there is not a numeric value against which TSS conditions in lower Succor Creek can be compared to determine compliance with the standards. Site-specific conditions must be assessed to determine an appropriate sediment target. The sediment target should be linked to conditions that will ensure the water quality standards are met. In the case of lower Succor Creek, the average irrigation season TSS concentration in the stream above Sage Creek will be considered the TSS target for the remainder of the stream. This value is 22 mg/L. The target of 22 mg/L TSS will be applied during the irrigation season (critical period) because, as displayed in Figure 2.50, the irrigation season is when nearly all of the loading occurs to the stream. The target of 22 mg/L represents the TSS conditions in the stream during a time of year loads are the highest, yet, as discussed below, aquatic life beneficial uses can remain supported. The target of 22 mg/L also represents TSS conditions only slightly above those arriving from Oregon where the immediate (to Idaho) land uses are relatively similar.

To address the suitability of 22 mg/L TSS as a target that will support cold water aquatic life, the TSS conditions in the lower Boise River (located northeast of Succor Creek in hydrologic unit 17050114) are used as a comparison. Speaking in terms of TSS conditions, the lower Boise River sediment TMDL (DEQ 1999) segmented the river into two reaches, above the city of Middleton and below the city of Middleton. Above the city of Middleton, the Boise River contains an irrigation season average TSS concentration of 15 mg/L. The irrigation season average SSC is 20 mg/L. It was determined in the lower Boise River TMDL that the concentration of SSC in the river above Middleton (20 mg/L) was not causing the impairment of aquatic life beneficial uses, including salmonid spawning. The target used in the Lower Boise River is 50 mg/L.

A TSS target in lower Succor Creek that directly corresponds with 20 mg/L SSC cannot be determined. However, when collected from the same water body, if TSS is low SSC is typically low as well. Based on this analysis, it is reasonable to assume that since 15 mg/L TSS is supporting aquatic life beneficial uses in the lower Boise River, 22 mg/L TSS will support aquatic life beneficial uses in lower Succor Creek. The two values are significantly similar in terms of their effect on fish. Additionally, an SSC concentration corosponding with 22 mg/L TSS would likely be below the 50 mg/L threshold established for the lower Boise River.

Figure 2.49 and Table 31 illustrate that over the course of a typical irrigation season, TSS concentrations in lower Succor Creek are in excess of 22 mg/L below Sage Creek. Total suspended solids load reductions are necessary from Sage Creek in order to maintain 22 mg/L. The TMDL portion of this document (Chapter 5) will identify the extent of the necessary reductions.

Table 31. Typical irrigation season total suspended solids concentration and load in lower Succor Creek.

Location	Concentration (mg/L)	Load (lbs/day)
Above Sage Creek	22 mg/L	2,562
Below Sage Creek	83 mg/L	30,692

Substrate Particle Size Distribution

Substrate particle size distributions are measured as part of the DEQ BURP program using the Wolman Pebble Count procedure (Wolman 1954). These data give information about the percentage of fine material (<6 mm in diameter) in the substrate and the overall distribution of larger material. Less than 30% fine substrate material in riffles is desirable for salmonid spawning and for a healthy macroinvertebrate community (Bjorn and Rieser 1991, Rhodes et al. 1994, Witzell and MacCrimmon 1983). Hence, less than 30% fines is a suitable surrogate used in other water quality studies and other TMDLs, including the lower Boise River and Garcia River (California).

Wolman pebble counts have been conducted at six locations in Succor Creek. Table 32 shows the location of each count and the relative percentage of fine substrate material at each site. Due to the small data set, these relative percentages have a low level of statistical rigor. However, until additional data can be collected, they represent the best available data.

Table 32. Percentage of fine substrate material (<6 mm) in Succor Creek.

Location	Date	Percent Fines
Near Homedale	8/01/01	57%
3.15 miles below Succor Creek Reservoir	8/20/02	51%
0.92 miles upstream from reservoir	6/02/94	28%
0.92 miles upstream from reservoir	6/07/95	17%
0.92 miles upstream from reservoir	6/19/02	23%
		Average = 23%
6.7 miles upstream from reservoir (Chipmunk Meadows)	6/02/94	50%
6.7 miles upstream from reservoir (Chipmunk Meadows)	6/06/95	54%
6.8 miles upstream from reservoir (Chipmunk Meadows)	8/08/95	29%
		Average = 44%
9.7 miles upstream from reservoir (Near Bergh Mine)	5/20/02	18%

Each of the locations in Table 32 are representative of a segment of Succor Creek. That is, the data are indicative of the overall conditions in the segment as they relate to substrate conditions. The representativeness is based on a variety of factors, including similar near stream land uses, channel types, and geographic location. For example, the stretch of stream below Chipmunk Meadows is considered a different segment than in Chipmunk Meadows because it is isolated by steep canyon walls and is not as readily available for grazing. Table 33 shows the segments of Succor Creek as they relate to the locations given in Table 32.

Table 33. Stream segments represented by BURP monitoring locations.

Location	Stream Segment Represented
Near Homedale	Oregon Line to Snake River
3.15 miles below reservoir	Succor Creek Reservoir to Oregon Line
0.92 miles upstream from reservoir	Tributary at T3S R5W Sec 1, SE to Succor Creek Reservoir
6.7 miles upstream from reservoir (Chipmunk Meadows)	Granite Creek to Tributary at T3S R5W Sec 1, SE

As indicated in Table 32, three segments of Succor Creek exceed the target of 28% fines in riffles. The land use data for upper Succor Creek (Figure 1.15) indicate that the primary land use is rangeland. Therefore, after the spring runoff event, stream bank erosion is most likely the largest source of sediment to the stream.

The Data Assessment Methods section of this chapter describes the linkage that has been developed between 80% bank stability and 28% fine substrate material in riffles. This linkage will be used to develop the TMDLs for each of the segments in Table 33 that exceed 28% surface fines. The TMDL portion of this document (Chapter 5) will identify the reductions necessary to meet 28%.

Temperature

The water temperatures in Succor Creek are only one element of the overall water quality. However, temperatures have a significant influence over the use of the stream by aquatic insects, fish, and even swimmers. Two sets of criteria apply to water temperature in upper Succor Creek, one for cold water aquatic life and another for salmonid spawning. These criteria are described further in Table 6. DEQ collected temperature data from upper Succor Creek and Cottonwood Creek (tributary to Succor Creek) over the summer of 2002. Additional data were collected in 1995 near Chipmunk Meadows. Temperature sampling sites can be seen in Figure 2.45. During the 2002 monitoring effort, HOBO temperature loggers were placed near the Berg Mine, directly above the reservoir, below the reservoir, and at the Idaho/Oregon line. Note that the period of record is not the same at all locations. The period of record was largely dictated by accessibility to the sites.

Figures 2.51 through 2.60 show the instantaneous and daily average temperature data from each location as it compares to allowable temperatures for cold water aquatic life and salmonid spawning. Note that on each figure the spawning period does not extend beyond

June 15. June 15 marks the end of the typical redband trout spawning period in the hydrologic unit (Appendix B). Additionally, at the site directly above the reservoir, data were not available during the spawning period. Only the cold water aquatic life period is assessed for Cottonwood Creek since it is not designated for salmonid spawning.

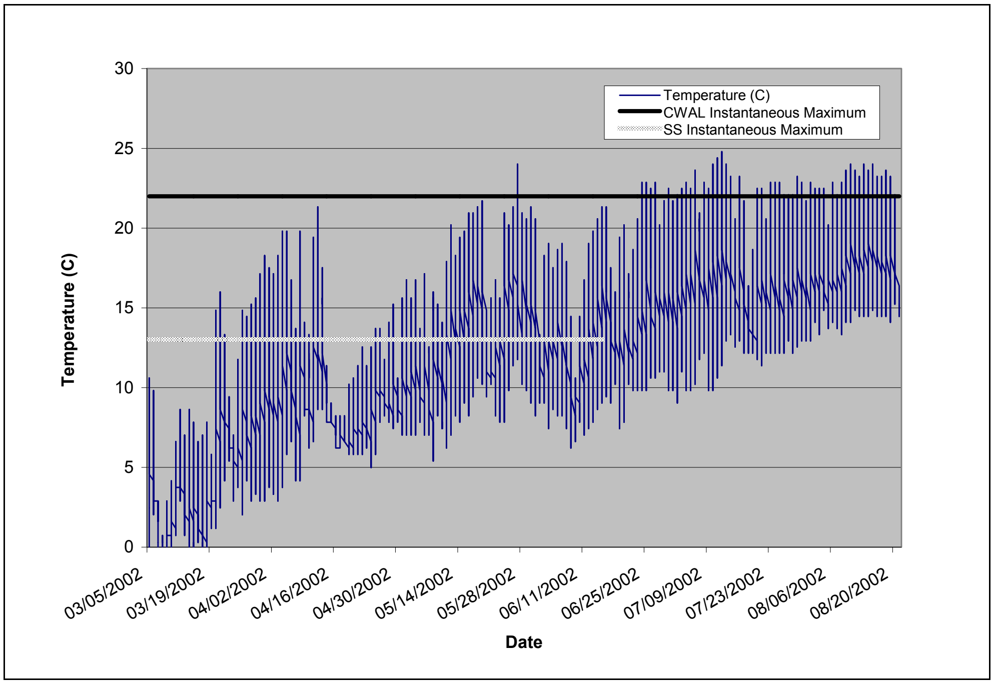

Figure 2.51 Comparison of the Cold Water Aquatic Life and Salmonid Spawning Instantaneous Water Temperature Criteria to Instantaneous Water Temperatures in upper Succor Creek at the Idaho/Oregon Line

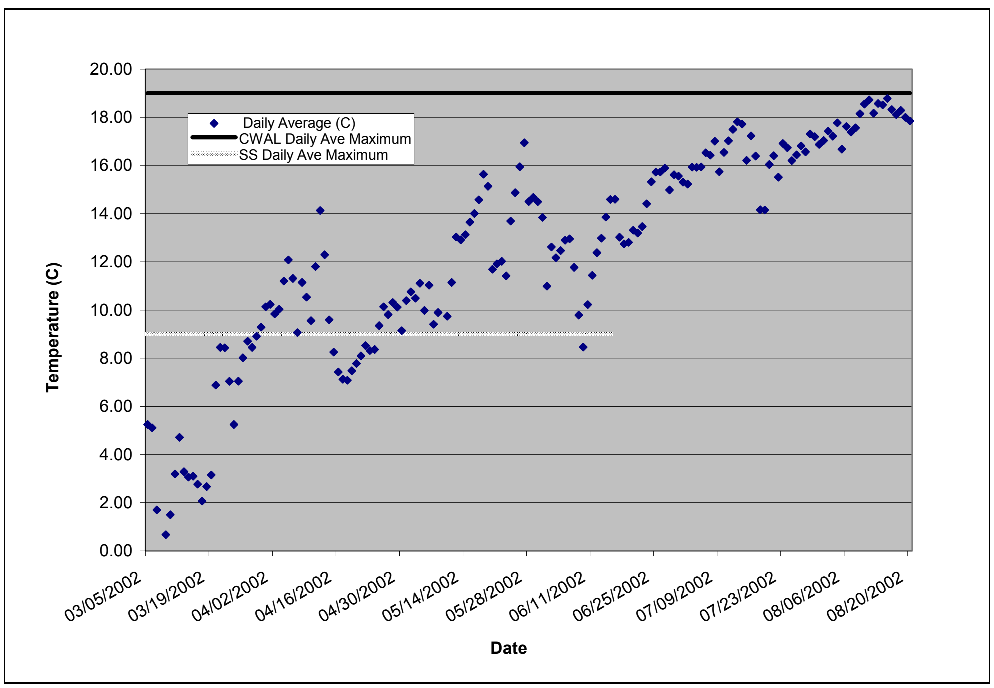

Figure 2.52 Comparison of the Cold Water Aquatic Life and Salmonid Spawning Maximum Daily Average Water Temperature Criteria to the Daily Average Water Temperatures in upper Succor Creek at the Idaho/Oregon Line

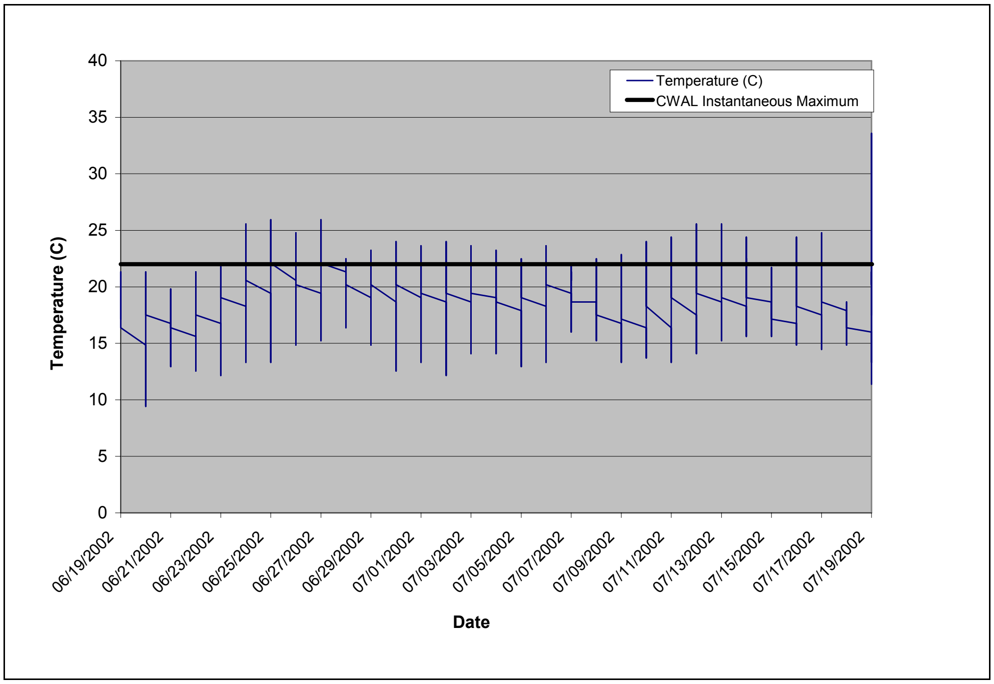

Figure 2.53 Comparison of the Cold Water Aquatic Life Instantaneous Water Temperature Criteria to Instantaneous Water Temperatures in Succor Creek Directly above upper Succor Creek Reservoir

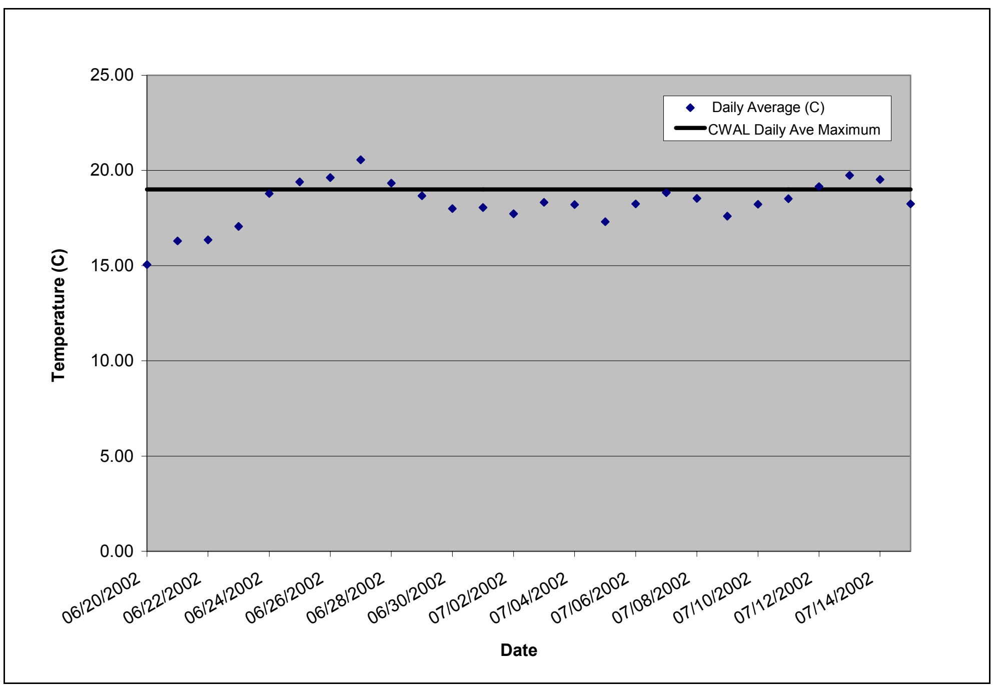

Figure 2.54 Comparison of the Cold Water Aquatic Life Maximum Daily Average Water Temperature Criteria to the Daily Average Water Temperatures in upper Succor Creek Directly above Succor Creek Reservoir

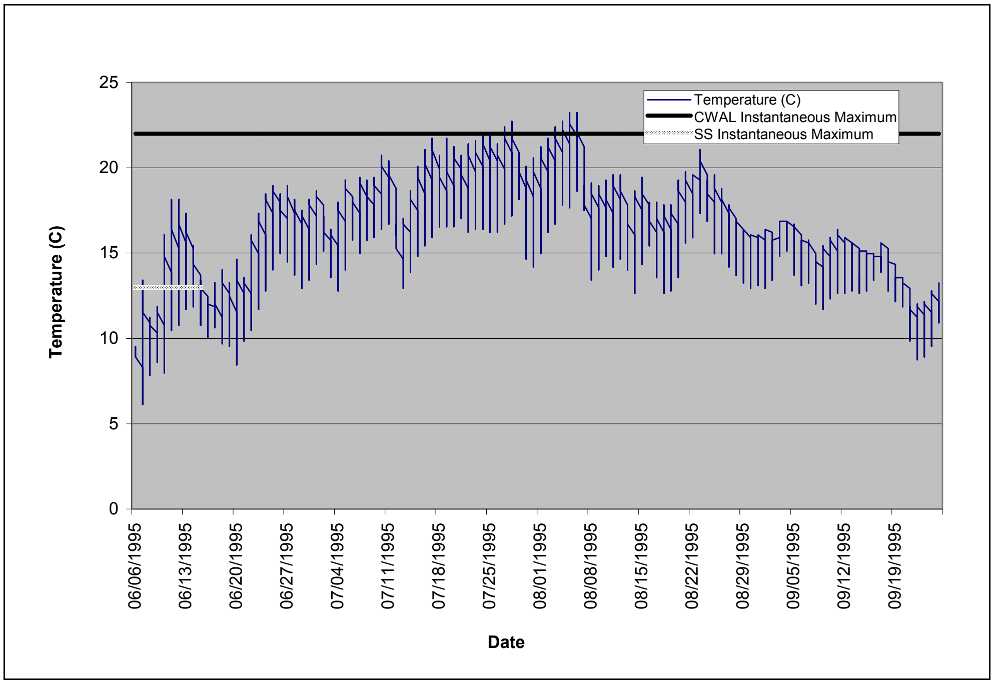

Figure 2.55 Comparison of the Cold Water Aquatic Life and Salmonid Spawning Instantaneous Water Temperature Criteria to Instantaneous Water Temperatures in upper Succor Creek near Chipmunk Meadows

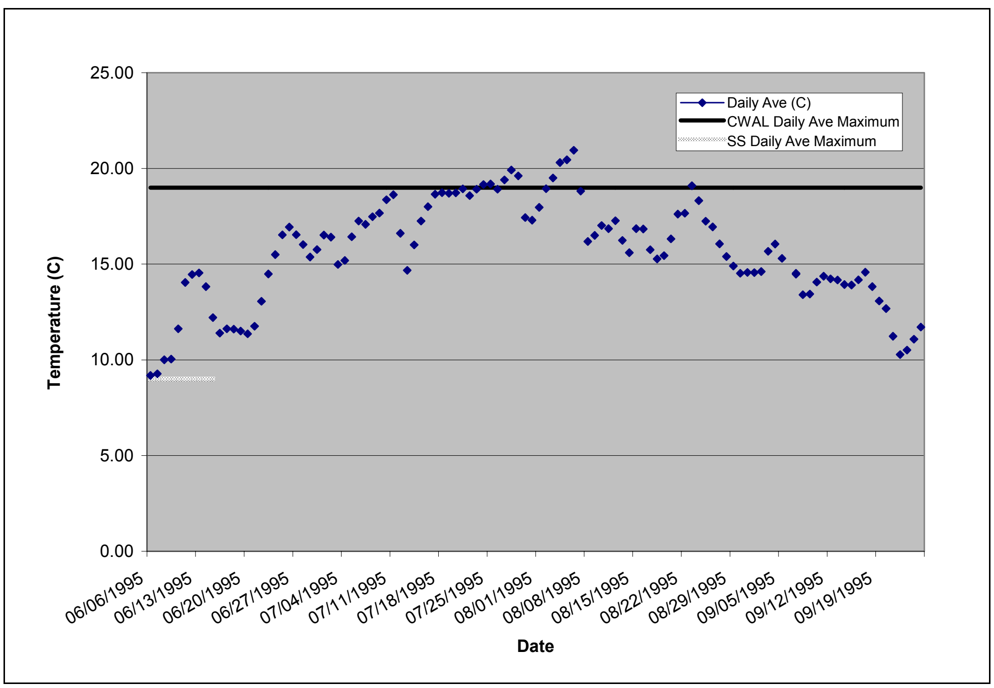

Figure 2.56 Comparison of the Cold Water Aquatic Life and Salmonid Spawning Maximum Daily Average Water Temperature Criteria to the Daily Average Water Temperatures in upper Succor Creek near Chipmunk Meadows

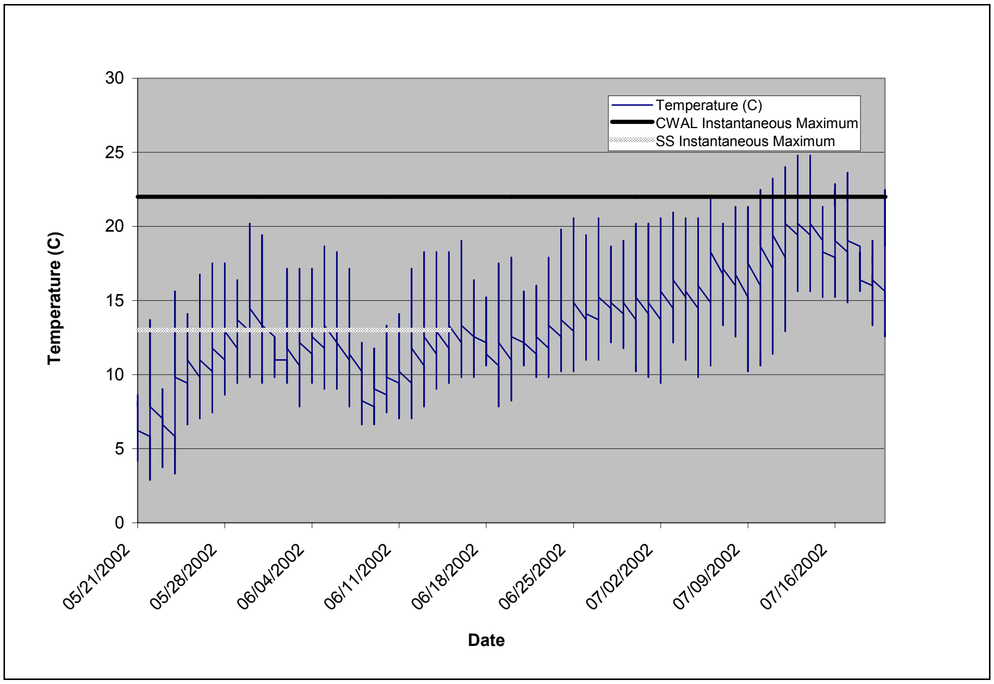

Figure 2.57 Comparison of the Cold Water Aquatic Life and Salmonid Spawning Instantaneous Water Temperature Criteria to Instantaneous Water Temperatures in upper Succor Creek near the Berg Mine

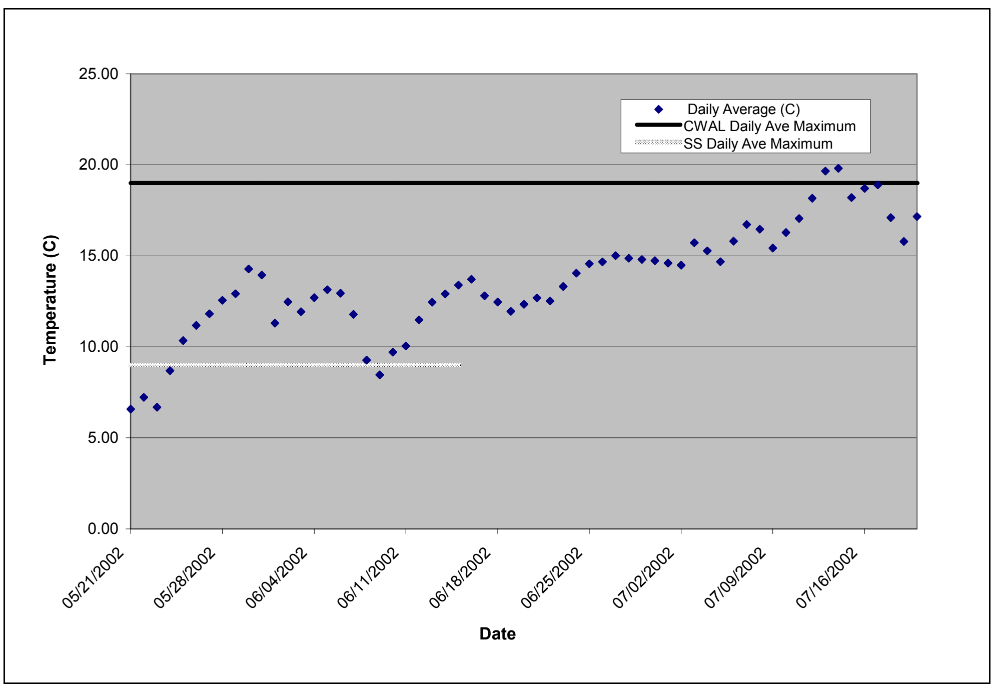

Figure 2.58 Comparison of the Cold Water Aquatic Life and Salmonid Spawning Maximum Daily Average Water Temperature Criteria to the Daily Average Water Temperatures in upper Succor Creek near the Berg Mine

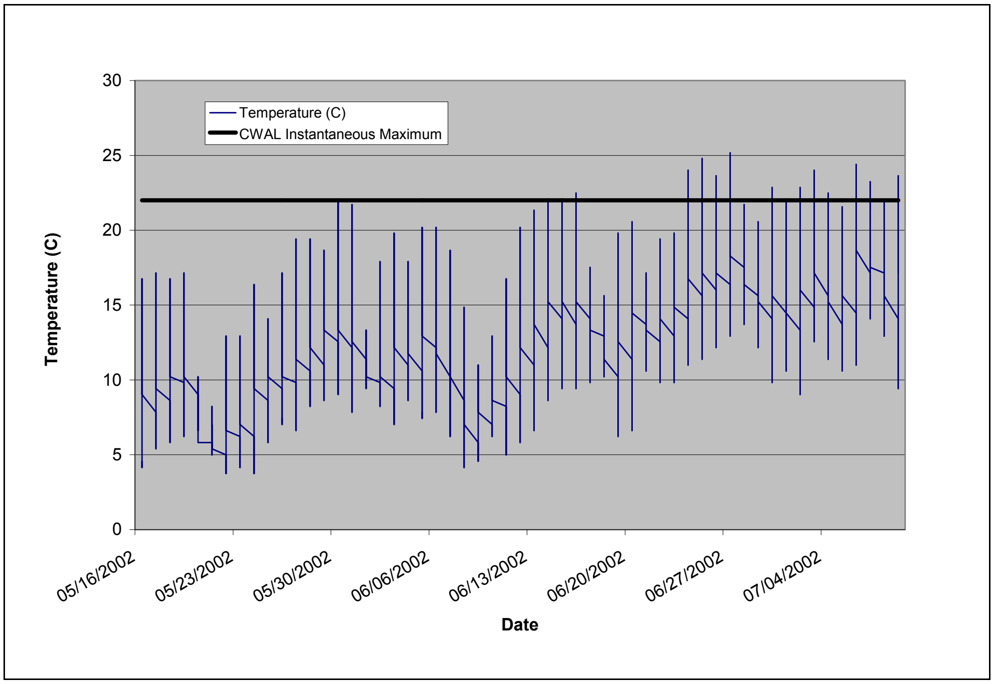

Figure 2.59 Comparison of the Cold Water Aquatic Life Instantaneous Water Temperature Criterion to Instantaneous Water Temperatures in Cottonwood Creek

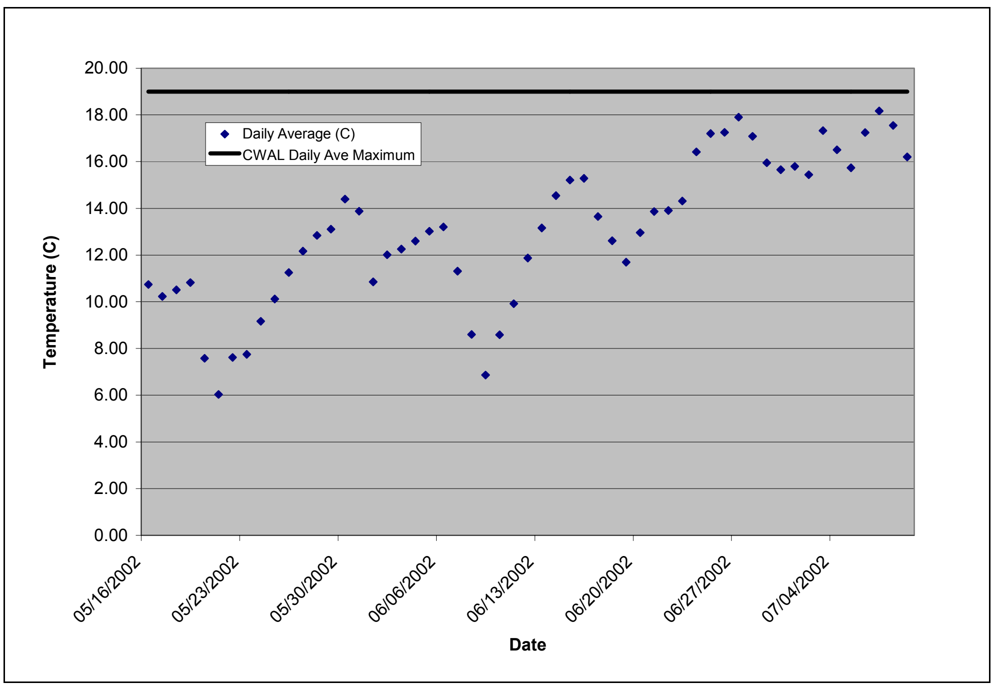

Figure 2.60 Comparison of the Cold Water Aquatic Life Daily Average Water Temperature Criterion to the Daily Average Water Temperatures in Cottonwood Creek

To evaluate the temperature data in upper Succor and Cottonwood Creeks as they pertain to the water quality criteria, the 10% guidance described in the EPA 305(b) guidance and integrated into WBAG II was used (Grafe et al. 2002). This guidance says that up to 10% of the available data during the defined critical period can exceed the water quality standard without violating that standard. The critical period for salmonid (redband) spawning is March 1 through June 15. The critical period for cold water aquatic life is June 22 through September 21. For example, during the redband trout spawning and rearing season (March 1 - June 15), up to 10% of the available temperature measurements can exceed the instantaneous criterion of 13 ^{o}C and the daily average criterion of 9 ^{o}C without the standards being exceeded. Tables 34 and 35 show the percentage of available water temperatures at each location exceeding the cold water aquatic life and salmonid spawning criteria during the critical periods. Directly above the reservoir, in Chipmunk Meadows and near the Berg Mine, temperature data were not available for the full extent of the critical periods. Hence, assumptions were made to accommodate for this lack of data. These assumptions are described below.

Table 34. Percentage of available water temperatures exceeding the cold water aquatic life criteria for the critical period of, June 22 through September 21.

Location	Exceed CWAL[1] Instant Maximum 22 ^{o}C	Exceed CWAL Daily Average 19 ^{o}C
At the Idaho/Oregon line Data available from 6/22 to 8/21	12%[2]	0%
Directly above Reservoir Data available from 6/22 to 7/19	16%[3]	19%[4]
Near Chipmunk Meadows Data available for the extent of the CWAL critical period	2%	9%
Near Berg Mine Data available from 6/22 to 7/19	6%	9%
Cottonwood Creek Data available from 5/16 to 7/9	9%	0%

[1]Cold water aquatic life
[2]Assumes that 12% of the measurements after 8/21 (to 9/21) remain above the criterion
[3]Assumes that 16% of the measurements after 7/19 (to 9/21) remain above the criterion
[4]Assumes that 19% of the measurements after 7/19 (to 9/21) remain above the criterion

Table 35. Percentage of available water temperatures exceeding the salmonid spawning criteria during the critical period of March 1 through June 15.

Location	Exceed SS[1] Instant Maximum 13 °C	Exceed SS Daily Average 9 °C
At the Idaho/Oregon line Data available for the extent of the spawning period	24%	65%
Directly above Reservoir Data available from 6/19 to 7/15	Insufficient Data	Insufficient Data
Near Chipmunk Meadows Data available from 6/6 to 7/15	4%[2]	11%[2]
Near Berg Mine Data available from 5/21 to 7/15	8%[3]	22%[3]

[1]Salmonid spawning
[2]Assumes that 100% of the measurements before 6/6 (back to 3/1) are below the criterion
[3]Assumes that 100% of the measurements before 5/21 (back to 3/1) are below the criterion

Tables 34 and 35 show that water temperature at the Idaho/Oregon line exceeds the criteria for salmonid spawning as well as the instantaneous maximum criterion for cold water aquatic life. The daily average criterion for cold water aquatic life is not exceeded. Exceedances of the salmonid spawning instantaneous maximum criterion begin to occur in early April and become chronic by late April. From late April through the remainder of the period the criterion is exceeded nearly every day. The timing of the salmonid spawning daily average exceedances is very similar to the instantaneous maximum exceedances. Again, the exceedances begin in early April and become chronic by late April, with the remainder of the period being over the criterion. The cold water aquatic life instantaneous maximum exceedances begin to occur in late June and extend throughout the summer months. Twelve percent of the available data exceed the cold water aquatic life criterion. However, due to insufficient data, the entire critical period for cold water aquatic life cannot be evaluated. Data are not available for the period between August 22 and September 21. To address this, it is assumed that 12% of the data for the remaining 30 days (8/22 - 9/21) continue to exceed the criterion. Given that September is typically a cooler month than August, this is a conservative assumption that is protective of the aquatic life resource.

Table 34 shows that the water temperature directly above Succor Creek Reservoir exceeds the criteria for cold water aquatic life. However, again due to insufficient data, the entire critical period cannot be evaluated. Actual data are only available from June 19 through July 15. To address this, the same approach as described above is used for cold water aquatic life. It is assumed that the remaining percentage of the measurements would exceed the criterion. The timing of the cold water aquatic life exceedances is difficult to determine due to the lack of data earlier in the year. However, based on the period of record, exceedances of the instantaneous criterion occur nearly every day throughout the summer months.

Data are not available directly above the reservoir during the critical period to assess salmonid spawning. This is the location where the logger was vandalized. However, as shown in Table 35, water temperatures exceeding the salmonid spawning criteria typify the remaining segments of the stream. Therefore, DEQ assumes that this segment of stream also exceeds the criteria. Given current shading conditions on upper Succor Creek above the reservoir, this is more than likely the case.

Table 34 shows that water temperatures near Chipmunk Meadows and the Berg Mine do not exceed the criteria for cold water aquatic life. However, Table 35 shows that water temperatures exceed the salmonid spawning daily average criterion, but not the instantaneous maximum criterion at both locations. Again, data are not available for the entire salmonid spawning critical period. If it is assumed that 100% of the measurements prior to June 6 and May 21 (the dates data become available at each location) are below the criteria, the percentage of instantaneous maximum criterion exceedances falls from 36% (not shown in table) to 4% near Chipmunk Meadows and 29% (not shown in table) to 8% near the Berg Mine. Both adjusted percentages are below 10%. At both locations the daily average percentage remains above 10% (11% near Chipmunk Meadows and 22% near the Berg Mine). The timing of the salmonid spawning criterion exceedances near Chipmunk Meadows is difficult to determine due to limited data. Near the Berg Mine, the data show that beginning in late May, nearly all of the values exceed the criterion.

Status of Beneficial Uses

The *E. Coli* data indicate that the primary contact recreation criteria are exceeded in lower Succor Creek (Oregon line to Snake River). Consequently, DEQ recommends preparing a bacteria TMDL for lower Succor Creek with the intent of reducing the *E. Coli* levels in the stream to levels that will meet the water quality standards.

The data also indicate that excess substrate sediment (sediment on the stream bottom) is impairing cold water aquatic life and salmonid spawning in two segments of upper Succor Creek (above the Oregon line). The segments impaired by sediment extend from Granite Creek to Little Cottonwood Creek (T3S, R5W, Section 1, SE - Chipmunk Meadows) and from the mouth of the Succor Creek Reservoir to the Oregon line. The segment of stream from the Sage Creek to the Snake River (lower Succor Creek) is also impaired by excess sediment. Consequently, DEQ recommends preparing a TMDL for sediment in these segments of Succor Creek with the intent of reducing the percentage of fine substrate material in upper Succor Creek and reducing TSS concentrations in lower Succor Creek.

Upper Succor Creek exceeds the temperature criteria for cold water aquatic life directly above the reservoir and at the Idaho/Oregon line. The cold water aquatic life criteria are not exceeded near the Berg Mine and in Chipmunk Meadows. Additionally, the salmonid spawning criteria are exceeded at all locations above the Oregon line. DEQ recommends temperature TMDLs at these locations. The issue of natural vs. anthropogenic heat will be addressed in the TMDL portion of the document.

Table 36 summarizes the beneficial use support status throughout Succor Creek as it relates to the pollutants of concern in the stream.

Table 36. Status of beneficial uses in Succor Creek.

Pollutant / Segment	Beneficial Uses Support Status	Impaired Use[1]	Comments
Sediment	--[2]	--	--
Headwaters to Granite Creek	Not Impaired	--	--
Granite Creek to T3S, R5W, Sec1, SE	Impaired	CWAL, SS	Excess fine substrate material, >28% fines
T3S, R5W, Sec1, SE to reservoir	Not Impaired	--	--
Reservoir to Oregon line	Impaired	CWAL, SS	Excess fine substrate material, >28% fines
Sage Creek to Snake River	Impaired	CWAL	Excess total suspended solids, >22 mg/L
Temperature	--	--	--
Headwaters to Berg Mine	Impaired	SS	CWAL not impaired
Berg Mine to Chipmunk Meadows	Impaired	SS	CWAL not impaired
Chipmunk Meadows to head of reservoir	Impaired	SS, CWAL	--
Ouflow of reservoir to Oregon Line	Impaired	SS, CWAL	--
Cottonwood Creek	Not Impaired		--
Bacteria (*E. Coli*)	--	--	--
Oregon line to Snake River	Impaired	PCR	--

[1]CWAL: cold water aquatic life, SS: salmonid spawning, PCR: primary contact recreation
[2]--: Cells left intentionally blank

2.4 Data Gaps

The best available data were used to develop the current subbasin assessment and TMDL. The data were used to reach conclusions of support status and to develop defensible TMDLs. However, DEQ acknowledges there are additional data that would be helpful to increase the accuracy of the analyses. The data gaps that have been identified are outlined in Table 37.

Table 37. Data gaps identified during development of the Mid Snake River/ Succor Creek Subbasin Assessment and TMDL.

Pollutant or Other Factor	Data Gap
Flow	Multiple year irrigation season flow data for lower Succor Creek and Jump Creek. Multiple year flow data for upper Succor Creek Multiple year flow data for those streams deemed intermittent as per Appendix E Multiple year flow data for Castle Creek and flow data for artesian water inputs into Castle Creek
Biological (fish and macroinvertebrates)	Additional salmonid presence/absence information for Succor Creek, particularly during irrigation flow and spawning periods
Bacteria	Multiple year bacteria data for lower Succor Creek and tributaries collected at a frequency sufficient to determine the monthly geometric mean *E. Coli* concentration.
Sediment	Multiple year irrigation season total suspended solids data for Succor Creek, Jump Creek, and their tributaries Multiple year total suspended solids data for upper Succor Creek Bedload data for Succor Creek and the Snake River Updated substrate particle size data for upper Succor Creek Multiple year total suspended solids data for Reynolds Creek
Dissolved Oxygen	Substrate/water interface dissolved oxygen measurements Continuous dissolved oxygen measurements taken at the end of the river reach
Temperature	Multiple year temperature data for upper Succor, Sinker and North Fork Castle Creeks, particularly during the salmonid spawning and cold water aquatic life critical periods Site-specific data to populate the SSTEMP temperature model, as per the guidance in Appendix G
Nutrients	Increased monthly sampling of nutrients, assessment of phosphorus recycling in system

Where viable, steps should be taken to fill the data gaps. Planned efforts to do so will be further outlined in the TMDL implementation plan. The information developed through these efforts may be used to revise the appropriate portions of the TMDL, and determine and/or adjust implementation methods and control measures. Changes to the TMDL will not result in the production of a new TMDL document. Minor changes will be in the form of addenda to the existing document(s). More extensive changes will be in the form of supplementary documentation or chapter replacement. Wherever practical, the goal is to build upon rather than replace the original work. The schedule and criteria for reviewing new data will be addressed in the TMDL implementation plan. The opportunity to revise the TMDL and necessary control measures is consistent with current and developing EPA TMDL guidance, which emphasizes an iterative approach to TMDL development and implementation. However, any additional effort on the part of DEQ to revise the TMDL or implementation plan and control measures must be addressed on a case-by-case basis, as additional funding becomes available.

2.5 Assessment Summary

Seven stream segments in the Mid Snake River/Succor Creek subbasin require TMDLs for sediment, nutrients, temperature, bacteria, or combinations thereof. Table 38 summarizes the stream segments addressed in this assessment and the actions that will be taken as a result of the assessment.

Table 38. Summary of subbasin assessment conclusions.

Water Body	Boundary	Listed Pollutants	Proposed Action
Snake River WQLS: 2670 AU: 006_07	CJ Strike Reservoir (below dam) to Castle Creek	Sediment	De-list sediment List TDG
Snake River WQLS: 2669 AU: 006_07	Castle Creek to Swan Falls	Sediment	De-list sediment
Snake River WQLS: 2668 AU: 006_07, 001_07	Swan Falls to Boise River	Bacteria, dissolved oxygen, nutrients, sediment, pH, flow alteration	De-list bacteria, sediment, pH TMDL for nutrients Dissolved oxygen will be addressed by the nutrient TMDL No action for flow alteration List temperature

Water Body	Boundary	Listed Pollutants	Proposed Action
Birch Creek WQLS: 2684 AU: 021_02, 03, 04	Headwaters to Snake River	Sediment	De-list sediment
Brown Creek WQLS: 2682 AU: 019_02, 03, 04	Headwaters to Catherine Creek	Sediment, Temperature	De-list sediment, temperature
Castle Creek WQLS: 2680 AU: 014_03, 04, 05	T5SR1ES28 to Snake River	Temperature, sediment, flow alteration	TMDL for sediment, Delay TMDL for temperature to collect additional data No action for flow alteration
Corder Creek WQLS: 2685 AU: 025_02	Headwaters to Snake River	Sediment	De-list sediment
Cottonwood Creek WQLS: none AU: 003_02	Headwaters to Succor Creek	Temperature	De-list temperature
Hardtrigger Creek WQLS: 2675 AU: 008_02	Headwaters to Snake River	Sediment	De-list sediment
Jump Creek WQLS: 2673 AU: 005_02,03	Headwaters to Snake River	Habitat Alteration	TMDL for sediment No action for habitat alteration
McBride Creek WQLS: 2672 AU: 004_02,03	Headwaters to Oregon Line	Temperature, sediment, flow alteration	De-list temperature, sediment No action for flow alteration
North Fork Castle Creek WQLS: 2680 AU: 014_02a	Headwaters to Castle Creek	Temperature	Delay TMDL for temperature to collect additional data
Pickett Creek WQLS: 2681 AU: 016_02, 03	T5SR1WS32 to Catherine Creek	Sediment	De-list sediment

Water Body	Boundary	Listed Pollutants	Proposed Action
Pickett Creek WQLS: 6681 AU: 016_02	Headwaters to T5SR1WS32	Temperature, sediment, flow alteration	De-list temperature, sediment No action for flow alteration
Poison Creek WQLS: 2687 AU: 006_02, 03	Headwaters to Shoofly Creek	Not Listed, See Chapter 1	No Action
Rabbit Creek WQLS: 2677 AU: 026_02	Headwaters to Snake River	Sediment	De-list sediment
Reynolds Creek WQLS: 2676 AU: 009_04	Diversion to Snake River	Sediment	De-list sediment
Sinker Creek WQLS: 2679 AU: 006_03	Diamond Creek to Snake River	Temperature, sediment, flow alteration	TMDL for temperature, sediment No action for flow alteration
South Fork Castle Creek WQLS: 2683 AU: 014_02	Headwaters to Castle Creek	Bacteria	Delay TMDL for bacteria to collect additional data
Squaw Creek WQLS: 2674 AU: 007_02, 03	HW to Snake River	Temperature	De-list temperature
Squaw Creek WQLS: 2674 AU: 007_03	Unnamed tributary 3.9 km upstream to Snake River	Sediment	De-list sediment
Succor Creek WQLS: 2671 AU: 002_04	Oregon line to Snake River	Sediment, flow alteration	TMDL for sediment, bacteria No action for flow alteration
Succor Creek WQLS: 6671 AU: 002_02, 03	Headwaters to Oregon line	Temperature, sediment	TMDL for sediment Delay TMDL for temperature to collect additional data